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The Colonial Forests and their Staffs

AS will be remembered, one of the problems considered by the first Empire Conference of Prime Ministers which met in London was the question of forestry in the Empire and the method by which a common and consistent forest policy should be formulated and adhered to afterwards by the individual parts. Empire settlement in connexion with forestry was one of the aspects to which attention was given. These matters were fully considered by a Forestry Subcommittee which was set up.

One of the dangers inherent in a problem of this type is the almost inevitable prominence given to the utilisation side of the question, obviously the best understood, and, it may be added, the best propaganda, when forests and forestry are in question. An examination of the memoranda and reports published displays the rather overwhelming preponderance given to the question of the world's timber supplies and the possibility of the Empire (a) becoming more or less self-sufficient in timber supplies, (b) developing larger export markets of her tropical timbers. It was recognised that there existed social and economic problems which necessitated each country in the world formulating a policy which should maintain a sufficient area of forest under a conservative management; and this recognition has been growing in force amongst those administrators and specialists who have given attention to this matter in the British Empire. Important, however, as the question of the world's existing resources in timber undoubtedly is, the accompanying and correlated one—the protection from needless destruction of the world's remaining forests, especially in the tropical and subtropical regions, and their proper management—is equally imperative. On three separate occasions this matter has been brought up at meetings of the British Association—in 1850, 1920, and 1926; whilst serious consideration was given to it by foresters interested in tropical forestry at the World's Forestry Conference in Rome in May 1926 (*vide* NATURE, Jan. 8, 1927).

As an outcome of the Oxford meeting of the British Association in 1926, Lord Clinton, chairman of the Forestry Subsection, drew up for the Council a short memorandum discussing the destruction of forests on hill slopes, with the well-known after-results, with especial reference to the tropical forests of the Empire. There was nothing new in this memorandum. The subject had been brought up before. But in the hands of so able

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a man as the chairman of the Forestry Commission it was believed that the question would receive a sympathetic consideration. The Clinton memorandum was submitted to the Secretary of State for the Colonies, by whom it was communicated to the governors of the various protectorates and colonies.

There was apparently no longer any doubt in the minds of the responsible authorities at the Colonial Office, as there could not have been in those of the Subcommittee of the Empire Conference, that certain practices to which a considerable proportion of the tropical forests of the Empire were still exposed should be stopped, or, at the least, efficiently regulated. The best known of these, by which annually the forests so treated are losing their value or being threatened with total annihilation, are shifting cultivation, excessive grazing of domestic stock, and the annual firing of the forest lands.

As, after the War, the Colonial Office had commenced to recruit trained men for all the various local forest services in the dependencies under that Office, there did not appear to be any reason why the action taken in 1926-27 should not at length meet with a decided and firm response from the several local administrations responsible for these valuable, and in many cases as yet commercially untapped, tropical forests. It may be stated at once that genuine attempts were made towards taking steps to give effect to the Secretary of State's wishes in this matter. Moreover, there were one or two young services which had been inaugurated since the War in which there was no lack of eagerness to commence the steps necessary to grapple with the unchecked and improvident habits of the local populations.

It would be impossible to discuss here the differences which obtain in the ownership, methods of local utilisation, and so forth, of these tropical forests. These vary with colony and dependency. But there is no, or little, variation in the results of the increasingly rapid destruction and deterioration of the forests exposed to the practices above-mentioned. As was seen in India, where formerly a similar state of affairs existed, no forest service in the world can attempt successfully to introduce measures for the regulation, control, and eventual suppression of these injurious acts unless it is strongly supported by the civil authority and, nowadays, by the governor's legislative council, which body will include a number of non-official members.

There can be little doubt that the result of the

active and far-sighted policy of the Colonial Office during the last decade has brought the forests of the protectorates and colonies into a prominent position, and that there now exists throughout the country some knowledge of their importance; and also of possible careers for active young men who make themselves efficient by a university training. To this point it may be said, therefore, that recognition has been given to the *need* for the conservation and effective management of the Empire tropical forests. But has effective action, necessary in every colony, been taken? Has a forest staff of sufficient strength been recruited? Mere lip service to a recognition of the perils to which a colony will be exposed by the further unchecked destruction of its tropical forest areas, or important sections of them, will not stop the sacrifice; and, each year it is allowed to continue, the destruction, with erosion, etc., proceeds at a greater rate.

Owing to the world-wide financial stringency, government staffs, as also commercial staffs, are so far as possible being reduced and recruitment has been kept at the lowest possible minimum. In the case of the colonial services, the forests have been treated on the same basis as other departments. It may be asked, is this policy, even though the forest department budgets are showing a temporary deficit (for adverse trade immediately reacts on forest receipts), correct or even sound, in the case of a colony possessing capital in the form of undeveloped forest areas subject to abuses and deterioration? Even while admitting that every sound effort should be made towards retrenchment, if the wishes and sentiments expressed by the Empire Conference and ministers on the matter of stopping the long-continued destructive practices of the populations living in, or in the vicinity of, tropical forests were anything more than a pious expression of opinion between 1924 and 1927, how has the position changed? It would appear to be even more vital—the more so since a perusal of the annual reports of the heads of the various forest departments in the colonies and dependencies for the past six years or so will disclose an almost unanimous complaint about the paucity of the staff and the necessity of strengthening it if real conservation was to be introduced; though in a few cases there has been a considerable expansion. In how many of these colonies is the practice of shifting cultivation as rife as it was twenty years ago?

These queries are not put with any idea of a criticism of the Colonial Office authorities. Far



otherwise, as will appear. In a recent article on "Forests and the Economic Crisis" in the *Empire Forestry Journal* (vol. 10, No. 2, 1931), Sir Roy Robinson deals with what he aptly expresses as the blizzard blowing over forestry. Sir Roy asks what foresters can do, and enumerates five points, covering inaction or action. In one of these he says: "If Forestry has proved an easy subject for drastic cuts it is because it had not made sufficient friends. In other words, our educational effort has not yet borne the desired fruits." It would appear that Sir Roy is regarding the matter chiefly from the point of view of forestry in Britain, where, apart from administrators and politicians, an educated forestry opinion in the public would be a strong asset. The position is, however, very different in the case of colonial countries, where an educated public opinion is non-existent, and where the point of view of the administration is the only one to be taken into account. Moreover, Great Britain does not possess any capital in the shape of large areas of undeveloped forests, which is commonly the case in the colonies.

This being so, the fact remains that in spite of the full recognition given to the importance of putting a stop to the destruction of tropical forest, a step which is only possible by having a strong forest department in the colony and backing it up with full official authority, forest staffs are actually being reduced, in a most drastic fashion, and recruitment stopped. In other words, in the interest of a perfectly understood and implicitly believed-in campaign of retrenchment, the development of the capital resources of a colony are being put back by a decade, whilst parts of the capital are subject to annual depreciation. Several instances could be quoted. The case of British Honduras presents some exceptional features and may be regarded as an extreme case; but it has the merit of exhibiting the problem in a manner calling for no expert knowledge upon which to base an opinion.

It is common knowledge that mahogany has been exported from British Honduras for several centuries. Not before 1922 was a small forest department inaugurated. Four years later this young department had six trained officers, the administration being placed under a Forest Trust. The forests were chiefly worked by lumbering companies on leases from government. The young department worked in well with the old methods and had begun to make a most promising headway. The *dénouement* exemplifies the purpose of this article and the question implied.

Should a financial deficit in a colony possessing considerable areas of undeveloped valuable tropical forest, at present subject to annual and increasing destruction, justify the abrupt stopping or serious checking of the work in hand or urgently needing being taken up? The following shows what has happened in British Honduras:

Owing to a falling off in forest revenue, the Unofficial Members of the Legislative Council signed a petition on Jan. 22, 1929, praying for a general curtailment of the forestry programme and reduction of Forest Trust expenditure. This petition, with comments by the Governor and his advisers,<sup>1</sup> was submitted to the Secretary of State for the Colonies, Lord Passfield. The reply was as follows, and is very instructive:<sup>2</sup>

"In another connection the attention of the Secretary of State had been brought to the disquieting probability that the revenue derived directly and indirectly from forest products will suffer very serious depletion at no distant date. For this reason, in addition to those adduced by the memorialists, he is convinced that the present structure of the Forest Department is heavier than the Colony's economic framework can sustain.

"At the same time, his Lordship is unalterably opposed to any amendment of the legislation governing the constitution, finance, and duties of the Forest Trust. British Honduras has depended upon its forest resources for 300 years; the approaching crisis in output will prove, it is earnestly to be hoped, of temporary duration; and the justification for providing machinery to regulate scientifically, so far as may be, the natural wealth of the Colony is as self-evident now as it was when his predecessor directed the creation of the Trust. His Lordship has accordingly reached the conclusion that the solution of the present financial difficulty is to be sought, not by altering the status of the Trust, but by curtailing its activities and consequent expenditure to the minimum consistent with the discharge of its routine duties, the preservation of its records, and the maintenance of the valuable experimental work already in hand. The adoption of this policy will ensure that when conditions justify the re-enlargement of the scope of the Trust, the nucleus of personnel and the knowledge and experience accumulated will be ready to hand. . . . His Lordship ventures to express the hope that the Unofficial Members of the Legislative Council will exercise the foresight which their position as guardians of the Colony's destinies demands and will lend their willing support in the policy here outlined."

These orders involved a cutting down of the staff, several officers being transferred elsewhere; the loss of the experimental sylvicultural work of great promise which had been commenced, for such work is doomed without the eye of the trained officer upon it; and the postponement of the



opening out of considerable areas of unknown forests in this Colony.

Lord Passfield may be congratulated on his firm attitude. Nevertheless, until it is recognised that a temporary fall in revenue in the case of inadequately staffed forestry departments should not be met by cutting down expenditure, staff, and so forth, no efficient or rapid progress can be made in the development of potentially rich but imperfectly known forest areas; whilst the delay in introducing an efficient check on indiscriminate acts of destruction is yearly reducing the value of this often irreplaceable asset.

This view of the matter finds strong support in a question connected with Empire timber supplies. In the annual report of the Forest Products Research Board of the Department of Scientific and Industrial Research, the increased interest of the public in Empire timbers is commented upon. The writers, however, stress the opinion that the joint work of the Department and the Empire Marketing Board was not in itself sufficient to cover the necessities of achieving a general development and national use of Empire timbers. Unless production and marketing are closely co-ordinated with research, the work of the Board will be impaired. Amongst other suggestions, the one "that some enlargement of the facilities at the disposal of the Forest Services" is timely. It appears obvious that if production, marketing, and research are to be efficiently co-ordinated, the first step is to go to the fountain-head and maintain or appoint a forest staff of sufficient strength to manage effectively the tropical forest areas in the several colonies.

<sup>1</sup> British Honduras, Report of the Forest Trust, 1930. Belize, 1931.  
<sup>2</sup> Reply to Petition by the Acting Colonial Secretary, dated Belize, Oct. 9, 1929.

### Anthropology in Indian Administration

*The Lakhers.* By N. E. Parry. With an Introduction and Supplementary Notes by Dr. J. H. Hutton. Published by direction of the Government of Assam. Pp. xx + 640 + 17 plates. (London: Macmillan and Co., Ltd., 1932.) 36s. net.

MR. PARRY'S volume on the Lakhers, for more reasons than one, is a notable addition to the valuable series of monographs on the Naga and other tribes of Assam, published under the direction of the Government of that Province. Apart from its intrinsic merits as a further record of ethnographic facts, owing to the circumstances in which it came to be written, it affords an illustration of the kind of material—the information re-

lating to native life and institutions, the language, customs, and beliefs—which should be mastered as a background for the work of administration. The book, as Mr. Parry explains, grew out of a series of brief notes collected with the object of recording those customs concerning which litigation most often arises among the people. The author speedily found, however, that custom was inextricably interwoven with the whole life of the people, and that anything short of a fairly complete knowledge of their daily life would give neither their point of view nor any idea of the practical effect of custom.

A further point in which Mr. Parry's book is exceptionally valuable is that it records the life of a people whose institutions have undergone little, if any, serious modification as yet through European administration. It was in 1924 only that the last of the Lakher villages were brought under British control. It is probable that the Lakhers may not have occupied their present situation in the south-east corner of the Lushai Hills for any great length of time. Judging from the number of abandoned village sites, it is estimated that their settlement must have taken place between two and three hundred years ago. Be that as it may, their first contact with the British appears to have been in the forties of the last century, when, as a part of the tribes then known collectively as the Shendus, they were regarded as a powerful and warlike nation—a reputation which appears to have rested to a great extent on lack of knowledge and the difficulty of getting into touch with them, rather than on any very great achievement in their numerous raids. Lakher villages first came under British rule when the Lushai Hills district was formed in 1889. A period of raiding and punitive expeditions followed, culminating in great tribal unrest after the War, which was brought to a close in 1924 with the annexation of the hitherto independent villages lying between Assam and Burma.

Peoples relatively primitive and absolutely untouched by European civilisation, who may be studied in conditions such as have favoured Mr. Parry, are becoming increasingly rare day by day. Anthropologists will be duly grateful to the author for seizing the opportunity of making this record of Lakher culture before any fundamental change had taken place. On the other hand, in modern conditions change is rapid, and while the static point of view may well prevail in certain departments of academic study, when it is desirable to apply the results of anthropological science



to a practical problem, as in administration, the dynamic point of view is essential. The questions which then become vital are the quality, degree, and direction of change which are likely to arise as a consequence of contact with European culture, and, of still greater moment, the repercussion of any modification of native custom which may have been introduced by administrative action.

On both these points Mr. Parry has information to record, which is all the more valuable because, administrative action having been confined to a minimum, the changes are few and readily isolated for purposes of study. The Lakhers themselves, though regretting their former freedom of action, admit that British rule has brought advantages in its train, especially in their freedom from ambush and raid, particularly during their beer parties. Now, as they say, they are no longer in danger of "being cut up while they are intoxicated". Although, on the whole, Lakher custom has been scrupulously respected, naturally an end has been put to the taking of human heads, which was customary on the death of a chief to terminate the mourning of his family and village. The mourning custom remains unchanged; but the head of a tiger, wild boar, or wild *mithun* (*Bibos gaurus* or *frontalis*) is now substituted.

In another direction also change has followed administrative action. The position and the importance of the chiefs have been affected by the liberation of the chief's slaves, or dependents, as Mr. Parry prefers to call them. Again, there is a tendency for the villages to become smaller. New settlements are founded by fission from the older with greater frequency than they were formerly, no doubt a result of the sense of greater security now enjoyed. It is probable, however, that in the long run the most lasting effect will follow from the new-found familiarity with and possession of money. This has accrued from the outlet now available for the disposal of the surplus production of rice in the recently annexed villages, where the inhabitants are more industrious and energetic than those of the villages which have been under British administration for some time.

At the risk of laying undue stress upon what is after all only one aspect of Mr. Parry's work, though undoubtedly of great importance, the question of cultural change may be carried a step further. Recent discussion of the place of anthropology in practical affairs has shown a tendency to disparage the claims of comparative study in favour of intensive observation of specific peoples.

While this is not the occasion to attempt a precise definition of the scope and function of the comparative method in such matters, it may be pointed out that a too exclusive attention to a culture as it exists and functions at the moment, without regard to its historic and developmental background, may lead to the neglect of inferences of moment in the study of the effect of cultural impact and the consequent modification, whether favourable or the reverse, in racial character, culture, and social organisation. Indeed it would seem at times, in such discussions as those to which we refer, as though it had almost been forgotten that European civilisation is by no means the only outside influence to which most of the less advanced peoples have been subjected. It is only by the employment of historical and comparative methods that the fact of such contacts, their succession and their results, often far-reaching, can be established.

This important aspect of Lakher culture is discussed in the valuable introduction contributed by Dr. J. H. Hutton, to whose knowledge and counsel the authors who have contributed to this series are so deeply indebted. He points out how the culture of the Lakhers serves to throw light on the stratification of culture of the Assam-Burma Hills. The Assam Hills are, as a matter of fact, in a sense, a key position in the study of cultural distribution in the south-east of Asia and the regions beyond. The Lakhers, it would seem certain, came from various points in the Chin Hills, presumably being pressed forward from the east as were the Lusheis. While some of their customs are typically Naga, and some typically Kuki, others appear to belong to neither of these cultures. Externally they appear to be definitely a Kuki tribe, their language and material culture associating them with the Chins. One interesting example of their affinity with the Kukis may be mentioned. In the legend of the theft of fire by a fly, among the Nagas the object stolen was the fire stick; but among the Lakhers, as among the Kukis, the secret was the flint and steel. The distribution of the institution of a separate house for the young men is also of no little significance. It occurs among the Nagas; but not among the Sema Nagas, although there appears to be a tradition of it. It does not occur among the Kukis, who may be responsible for its absence among the Sema; and the Lakhers follow the Kukis. With both of them, each of the young men takes up his lodging for the night in the house of any young girl to whom he may take a fancy. Yet in his attachment to his village site and to the



graves of his ancestors, Dr. Hutton points out, the Lakher is essentially a Naga.

In conclusion, it is perhaps permissible to recall that Assam has been singled out of late for favourable comment in the Press for its attitude in recent and still continuing troubled times. Might not the credit, at least in part, have been given to a Government which appreciates, and encourages its officers to adopt, a scientific approach to the problems of administration among a non-European people?

### The Differential Equations of Physics

*Partial Differential Equations of Mathematical Physics.* By Prof. H. Bateman. Pp. xxii + 522. (Cambridge: At the University Press, 1932.) 42s. net.

THE main work of mathematical physicists is to represent the sequence of phenomena in time and space by means of differential equations, and to solve these equations. Even the revolution effected by relativity and quantum theory has not changed this fundamental fact. A few years ago, indeed, when the discrete nature of quantum phenomena was being emphasised, it seemed as if differential equations might be replaced in ultimate physics by difference equations: but the discovery of wave mechanics restored the *status quo ante*, and to-day differential equations are more important than ever before.

The differential equations of physics form a class by themselves, though it is not easy to characterise them by a formal definition. In a general way, we may say that physical laws are of the nature of minimum principles (for example, a chain suspended from two points assumes that form which makes the height of its centre of gravity a minimum; a ray of light passing through any number of lenses takes that path which makes the time of passage a minimum; two substances which can change physically or chemically into each other, when placed in contact at a given pressure and temperature, take up that state which makes the thermodynamic potential a minimum; and so on). Therefore the differential equations of physics are essentially the differential equations which solve minimum problems; that is, they are the differential equations which arise in the calculus of variations. With this definition, however, some of the familiar equations, such as the equation of conduction of heat, can only be brought in awkwardly as limiting cases; and perhaps it is best to abandon the search for a definition, and simply to take as

subject matter the equations which have actually been encountered in physical investigations, trusting to exhibit the essential unity of their theory in the course of developing it.

In most cases the problem is to determine a function of the time and the co-ordinates, which in a given domain satisfies some linear partial differential equation of the second order, and also satisfies certain conditions at the boundary of the domain and certain initial conditions corresponding to a given value of the time. The first problem is to find the nature of the initial and boundary conditions which are necessary to determine a solution uniquely. Here the most surprising facts confront the beginner: thus in the case of the equation

$$\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0,$$

a solution is uniquely determined at points in the interior of a closed curve in the  $xy$ -plane when the value of  $u$  is given at all points of the curve: whereas in the case of the equation

$$\frac{\partial^2 u}{\partial x^2} - \frac{\partial^2 u}{\partial y^2} = 0,$$

which differs from the former only by a change of sign, a solution is uniquely determined when the values of both  $u$  and  $\frac{\partial u}{\partial y}$  are given along an open

curve. The complete resolution of these apparent contradictions by means of the theory of characteristics is one of the most entrancing chapters in mathematics: and as the student proceeds to learn about autovalues (or proper values, or characteristic values, or eigen values, as you please) and autofunctions, about Green's functions and Riemann-Green functions, about the Kirchhoff-Huygens theory of solution by integrals, and the many other properties that are common to large classes of these differential equations, he realises that he is dealing not with a loose collection of examples but with a coherent and unified doctrine which is as fascinating to the pure mathematician as it is important to the physicist.

The need for a substantial modern treatise on this subject has long been recognised: but prospective authors have been deterred by the appalling list of qualifications which the writer of such a book should possess. The first treatise on these equations, written more than a century ago—Fourier's "*Théorie analytique de la chaleur*"—contained more than five hundred quarto pages: since then, more than a hundred thousand pages of memoirs on them must have appeared. An author to-day should know thoroughly the older



mathematical physics—hydrodynamics, elasticity, sound, conduction of heat, thermodynamics, physical optics, electromagnetic theory—and also the newer branches—aerodynamics, general relativity, wave mechanics. Moreover, he must be a first-class pure mathematician, capable of distilling the essence from the gross matter and presenting in a book of reasonable size an orderly account of the ideas and principles and methods by which mathematical physics has been advanced.

The announcement made a year or so ago, that Prof. Harry Bateman—Senior Wrangler in 1903, fellow of Trinity College, Cambridge, and now professor of mathematics at the California Institute of Technology—had undertaken this task, was therefore received with a lively hope and interest: for Prof. Bateman is one of the most eminent living scholars in this domain. The work, which is now published, is one of the gigantic blue-bound tomes to which the Cambridge Press has accustomed us: xxii + 522 pages, and highly condensed at that. An examination in detail fills one with admiration for the author's skill and learning: he seems not only to have read everything, but also to be capable of proving any theorem more neatly than its original discoverer. The analytical dexterity which was fostered by the old Cambridge tripos was never more brilliantly displayed.

Unfortunately, there is another side to the picture: it is not possible to mention the great merits of the book without admitting that it has one serious defect. This is, the lack of what one may call architectural structure: I mean, of design, selection, and arrangement. The author seems to pour out his treasures pretty much as they come into his mind, and presents his results without clearly disentangling the essential points on which attention should be focused, and without ordering the whole on any recognisable plan. The trouble is, I think, partly due to the fact that he does not seem to have quite made up his mind what class of readers he is writing for, but ranges over the whole breadth of his own erudition. At one time we hear about Lebesgue integrals, at another technological details about the moisture in the heartwood of a piece of Sitka spruce. In one place he proves the ordinary Lagrange's equations of motion in dynamics. But is it likely that anyone who was not already acquainted with Lagrange's equations would tackle a 500-page book on the partial differential equations of mathematical physics?

The early chapters are the least satisfactory, because it is there that we notice most the failure

to set leading principles in a high light. When the author gets to the middle of the book, and displays his analytical skill successively with polar co-ordinates, cylindrical co-ordinates, ellipsoidal co-ordinates, paraboloidal co-ordinates, and toroidal co-ordinates, we feel that we are reading the work of a master.

One wishes the author had treated some things more fully; for example, the theory of characteristics (on which §§ 1.92 and 2.24 are scarcely adequate), or the general theory of conservation laws (on which he gives only some results set as examples on p. 183), or the interesting differential equations which occur in general relativity (particularly in connexion with the electromagnetic field), or the differential equations of wave mechanics. But one feels that criticism is ungracious: for the book is indeed unique, an invaluable work of reference, a thesaurus which no college or university library, and no working mathematical physicist, can afford to be without.

I have noticed only one error, namely, on p. 181, where the introduction of electromagnetic momentum is attributed to Abraham and Poincaré (whose papers appeared in 1900–2). The credit for this important discovery properly belongs to J. J. Thomson, who published it in 1893 in his "Recent Researches in Electricity and Magnetism".

E. T. WHITTAKER.

### Chemical Elements at a Glance

*Chemischer Handatlas: Anorganische Chemie unter besonderer Berücksichtigung von Atomphysik und Atomchemie. Graphische Darstellung der Eigenschaften chemischer Elemente und ihrer Verbindungen nach der Anordnung des natürlichen Systems der Elemente auf 60 vielfarbigen Karten mit Beschriftung in deutscher, englischer, französischer, italienischer, spanischer Sprache nebst ausführlichem, erläuterndem Texte.* Von W. Walter Meissner. Pp. xi + 77 + 60. (Braunschweig, Berlin und Hamburg: Georg Westermann, 1931.) 38 gold marks.

THE modern developments of the theory of atomic structure are intimately connected with the periodic system of the elements, and it has become increasingly necessary and important to have available some scheme in which the various properties of the elements can be exhibited as a connected whole, so that comparison between values for the elements can be made. This suggests that the properties concerned should be represented by some kind of symbols, the size of which should



convey an idea of the magnitudes. The "Atlas der physikalischen und anorganischen Chemie" of A. von Antropoff and M. von Stackelberg, published in 1929, carried out the scheme in a number of loose sheets, printed in black, and accompanied by a separate volume of text. The atlas of Meissner, which is more convenient in size, and is bound together as text and plates in one book, carries the systematisation a step further, since colours are employed, and, in addition to lines of varying lengths, there are figures of various shapes denoting special properties.

Although at first sight the result may seem a little complicated, a few minutes spent over the book will enable the reader to grasp the general plan and to understand without difficulty the symbolism used. The text is in German, the other languages being used only for the headings of the charts. A great amount of information is compressed into the text, and, what is more, references to the original literature are included. The main interest is in the direction of atomic structure, but the charts cover a wide field, including such matters as geographical distribution, a history of the chemical elements (a valuable and unusual feature), solubilities, and even analytical separations. It is clear that the amount of information contained in the atlas is really very considerable, and the book may be warmly recommended as likely to be most useful not only to chemists but also to workers in other sciences who wish to obtain an impression of modern chemical science, and to follow this up by reference to the original literature.

Among such a mass of detail errors are unavoidable, and it is to be hoped that in the preparation of future editions a close revision of the whole will be carried out, since the value of such a compilation is seriously affected if it is not absolutely accurate. In Table 48, for example, two values (143.1 and 143.9) are given for the heat of formation of magnesium oxide, and the formula of fluorine oxide is printed incorrectly. The scale of solubilities in Charts 52-57 is only half the correct size (as is pointed out in the list of errata on p. 77), and this should be put right in future editions. There are other similar errors, and the book would be improved by a careful overhaul. The text is also, for English readers, likely to prove rather difficult by reason of the unusually long and involved sentences and long words. This is no doubt a consequence of the necessity for condensation in the text, which has enabled a large amount of information to be given opposite each plate.

This atlas will prove of great use to teachers and

lecturers, since it provides much material in a brief form suitable for incorporation into lecture courses. The charts are well conceived and, on the whole, well executed, and the advantage of having the text bound together with the charts and facing them is obvious. The price is rather high.

### Short Reviews

*Gmelins Handbuch der anorganischen Chemie.* Achte völlig neu bearbeitete Auflage. Herausgegeben von der Deutschen Chemischen Gesellschaft. Bearbeitet von R. J. Meyer. System-Nummer 8: *Jod*. Lieferung 1. Pp. 244. 37 gold marks. System-Nummer 45: *Germanium*. Pp. xviii+iii+62. 13 gold marks. System-Nummer 59: *Eisen*. Teil B, Lieferung 4. Pp. 657-872. 28 gold marks. (Berlin: Verlag Chemie G.m.b.H., 1931.)

THE first part of the volume on iodine deals with the element itself, consideration of its compounds being reserved for the second part. The authors claim, in an introductory note, to have produced not only a comprehensive survey but also a critical monograph on the subject. Elaborate details of the occurrence of iodine are given, not only in various minerals, fossils, and natural waters, but also in a multitude of different species of plant and animal life. The iodine content is in many cases exceedingly small, so that in cases where the milligram is too large a unit for convenience, the symbol  $\gamma$  is used to denote one-thousandth of this amount. The physical and chemical properties of the element are carefully surveyed and a lengthy section deals with the action of various solvents upon it. An interesting special feature of this volume is the commercial section, which is illustrated with graphs showing the annual output of iodine in Chile since 1868 and in Java since 1892. The world production in 1929 is given as 1650 tons, of which only about thirty tons were produced in Great Britain.

The literature on germanium has been reviewed up to May 1931, but the work of Müller, Pike, and Graham in 1926 on the preparation of the pure metal, its melting point *in vacuo*, and its volatility in various gases, has been overlooked. The volume opens with an account of Mendeléeff's prediction of the existence of eka-silicon, the discovery in 1885 by Weisbach of the mineral argyrodite, the analysis of the latter by Winkler, and the ultimate recognition of the new element which it contained. The relationship of germanium to carbon and to silicon is clearly brought out in the volume, and a list of organo-germanium derivatives is tabulated.

The fourth section of part B of the volume on iron completes the survey of that element and deals chiefly with ferrous and ferric ferrocyanides, ferrous and ferric ferricyanides, other complex cyanides, and sulphocyanides of iron. Then follows an account of the compounds of iron which contain silicon, phosphorus, arsenic, antimony, and bismuth. The volume concludes with a lengthy section upon the general reactions of ferrous and ferric compounds which can be used in analytical work.



*Die elliptischen Funktionen von Jacobi: Fünfstellige Tafeln, mit Differenzen, von  $sn u$ ,  $cn u$ ,  $dn u$  mit den natürlichen Zahlen als Argument, nach Werten von  $m (=k^2)$  rangiert, nebst Formeln und Kurven.* Von Prof. L. M. Milne-Thomson. Pp. xiv + 69. (Berlin: Julius Springer, 1931.) 10.50 gold marks.

THE scope of this work is explained by its title. The author has succeeded in condensing into a very small space three quite adequate tables of double entry, which should be very useful to all who need numerical values of elliptic functions. Entries to five places of decimals are sufficient for nearly all practical purposes, and, by restricting the entries in this manner, the author has made it possible to interpolate not only (vertically) for  $u$ , but also (horizontally) for  $m$ ; the vertical interpolations are facilitated by the insertion of a table of first differences.

The tables are beautifully printed; the only defect in them which has been noticed is a dropped digit on p. 14. An introduction of eight pages gives a compact set of integrals and other formulæ, which add to the value of the book. Tables of elliptic functions, being essentially tables of double entry, are extremely scanty in number; the only existing tables with which these can reasonably be compared are Glaisher's much more elaborate tables of the theta functions, which are, as yet, unpublished. The publication of Glaisher's tables will not, however, make Milne-Thomson's tables superfluous, since elliptic functions can be obtained from Glaisher's tables only as the quotient of two entries.

We welcome with enthusiasm the volume under review. Before its appearance, on the occasions (not, it is true, very numerous) on which numerical values of elliptic functions were needed, the reviewer's usual procedure was to take the Smithsonian Tables and to waste perhaps half an hour in trying to unravel the mysteries of their notations; then to put them aside in exasperation and to compute the values required by means of  $q$ -series. The present work will not be the cause of similar trials of patience.

G. N. W.

*Anatomy in the Living Model: a Handbook for the Study of the Surface Movements and Mechanics of the Human Body and for the Surface Projection of the Viscera, etc.* By Prof. David Waterston. Pp. xvii + 255 + 16 plates. (London: Hodder and Stoughton, Ltd., 1931.) 25s. net.

WE welcome the appearance of Prof. Waterston's useful manual of surface anatomy, which is illustrated with numerous figures in monochrome and colour by that excellent draughtsman the late Mr. J. T. Murray, whose death just after the completion of the beautiful drawings in this book is a serious loss to anatomy. The book gives a careful account not only of the modelling of the body and the relations of the surface markings to the deep structures, but also to the texture of the skin and what can be learned in the living from its reactions to stimuli.

It is unfortunate, however, that a book dealing primarily with the living subject should omit any

adequate reference to the chief means now at the service of the anatomist for studying the living—namely, X-ray photography. The author of the present book admits this omission, but excuses it by the surprising statement that "X-ray examination covers too wide a field and is too specialised a matter to be included here". But the information obtained by the use of X-ray photography cannot be regarded as "too wide" or "too specialised" to be expressed in the drawings. Although the work is dealing with the *living* body, the most beautiful of Mr. Murray's drawings (Plates XI. to XIV. and Figs. 70 to 74) obviously represent in the *dead* body conditions which profoundly differ from those which obtain in the living.

*Recent Advances in Organic Chemistry.* By Prof. Alfred W. Stewart. Sixth edition. Vol. 1. Pp. xii + 429. Vol. 2. Pp. xii + 432. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1931.) 21s. net each vol.

AS compared with the fifth edition (see NATURE, Dec. 24, 1927, p. 908), the new volumes have been augmented by 42 pages and 50 pages respectively, and two plates illustrating space-models of hexamethylene and reduced naphthalene rings have been inserted. The general plan of the work remains unaltered. New matter, illustrating important researches of the last few years, has been incorporated: thus, vol. 1 contains a chapter on the polymethylenes and some large carbon rings, in which noteworthy work by Ruzicka and his collaborators is discussed; and vol. 2 includes an account of di- and tri-terpenes (the camphorenes and squalenes), the decalins and other fused ring-systems, and the diphenyl problem. The new edition will continue to lighten the labours of advanced students and research workers who are interested in the fields which Prof. Stewart has selected for treatment in this valuable publication. For the work to remain true to its title, however, we suggest that some of the older and more familiar material ought to be replaced by sections on cholesterol, vitamins, and other subjects of current importance; the account of electronics in organic chemistry also calls for expansion. J. R.

*Outline of Comparative Embryology.* By Prof. Aute Richards. Pp. xvi + 444. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1931.) 30s. net.

THE first part of this book deals with those embryological processes which are common to most of the higher animal forms, and presents in assimilable form the accepted views on cleavage, germ layer formation, the egg, and embryonic membranes, including the placenta. The consideration of various invertebrate forms is based largely on the work of Korschelt and Heider. The second part of the book deals with modern problems in embryology, and presents the modern aspects of asexual reproduction, parthenogenesis, and polyembryony with clarity. The historical aspect is well maintained, and the recent expansion of experimental embryology is admirably incorporated.



## Canadian Water Power Development in 1931

By Dr. BRYSSON CUNNINGHAM

THE development of hydro-electric power in Canada continues to make progress at a striking rate, the figures published in the latest returns of the Dominion Government<sup>1</sup> showing an increment of more than half a million installed horse power for the year 1931, as compared with rather less than 400,000 horse power for the preceding year. Looking back over a period of twenty years, it can be seen that the aggregate increase to date is just five million horse power, so that the actual rate of increase for the past twelve months stands considerably above the average. The total development to the end of the year 1931 is 6,666,337 horse power, or about 15½ per cent of the total recorded water power resources available.

Figures of such magnitude are difficult to realise by any effort of mental vision. Translated into terms of coal fuel at the most recently determined equivalent of 5¼ tons of coal per horse power in continuous operation throughout the year, the existing installations of the Dominion represent a potential saving in coal consumption of approximately 35 million tons per annum, an economy of notable dimensions, especially in a country where nearly all coal has to be imported from abroad. Measured in terms of population, there is 644 developed horse power per 1000, and in one province (Quebec) the proportion is 1.081 horse power per head. On the financial side, the capital invested in the various undertakings is estimated at more than 1514 million dollars. The accompanying table gives a detailed analysis

of the allocation of power among the leading industries for each of the provinces of the Dominion.

The distribution of energy among the provinces is, as might be expected, far from uniform. Quebec and Ontario, industrial regions of high productivity, possessing no natural deposits of coal within their borders, make by far the largest demands for

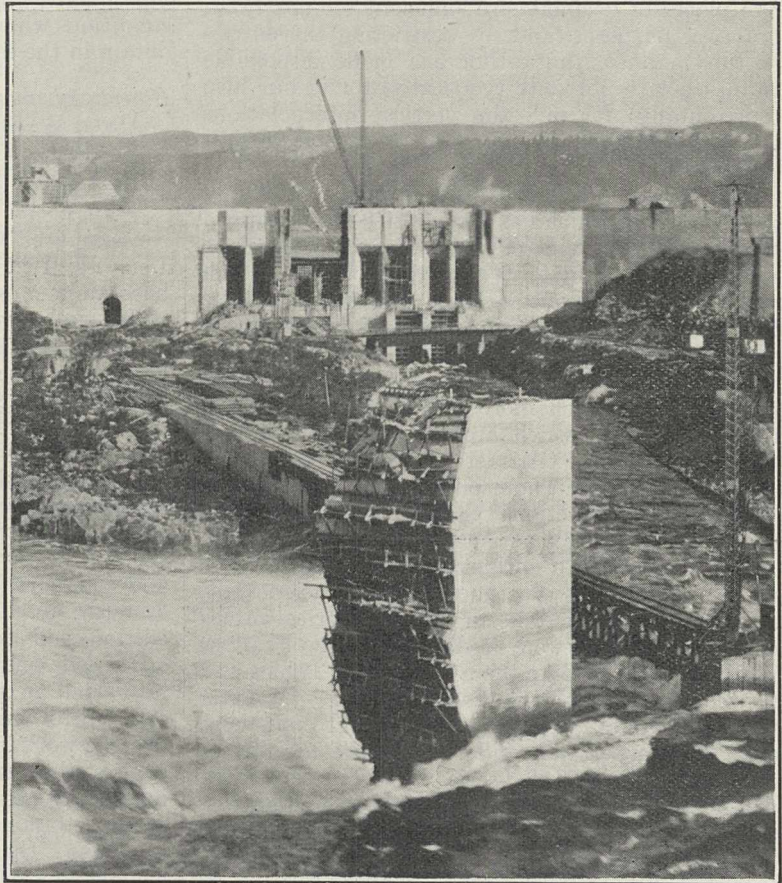


FIG. 1.—The ' obelisk ' for damming the main stream of the Saguenay River in course of construction. By courtesy of the High Commissioner of Canada.

## DEVELOPED WATER POWER IN CANADA: DISTRIBUTION BY PROVINCES AND INDUSTRIES

Province.	Turbine Installation: Horse Power.			
	In Central Electric Stations.	In Pulp and Paper Mills.	In Other Industries.	Total.
British Columbia .	489,360	105,800	60,832	655,992
Alberta . . . . .	70,320		212	70,532
Saskatchewan . .	42,000		35	42,035
Manitoba . . . . .	390,925			390,925
Ontario . . . . .	1,809,923	240,880	94,402	2,145,205
Quebec . . . . .	2,742,425	222,160	134,745	3,100,330
New Brunswick . .	104,960	19,778	8,943	133,681
Nova Scotia . . . .	84,202	12,378	15,419	111,999
Prince Edward Island . . . . .	376		2,063	2,439
Yukon and North-West Territories . . . . .			13,199	13,199
Dominion . . . . .	5,734,491	600,996	330,850	6,666,337

power, and, fortunately, possess correspondingly large hydraulic assets. Quebec has an aggregate installation of 3,100,330 horse power, of which 382,200 horse power was provided last year. Ontario's aggregate is 2,145,205 horse power, of which 58,200 horse power was last year's contribution. These two provinces stand far ahead of all the others, the nearest to them being British Columbia with a present installation of 655,992 horse power. The total water power resources of the Dominion, estimated on the basis of the information available at the present time, are of the order of 43 or 44 million horse power.

To review the development of the respective provinces would take too long, and would involve a recital of sites and powers which would occupy more space than can be spared. From the con-



siderable number of installations, the following example is selected for brief notice, as it exhibits some features of remarkable interest. It is the largest of the undertakings brought to completion during the twelve months under review, and it is notable alike for the gross capacity (260,000 horse power) of the station and for the magnitude (65,000 horse power) of each of the four units of operating plant.

Chute à Caron is the name of a fall on the river Saguenay, in the province of Quebec, which runs from Lake St. John and discharges into the St. Lawrence. An earlier development at Isle Maligne,

second is known as the Shipshaw project. The former has involved the construction of a massive concrete dam across the river Saguenay, just above the Chute à Caron rapids, and the temporary diversion of the river through the power-house until such time as the Shipshaw works are completed, when the river will be restored to its former bed and the Chute à Caron station will be used merely as a stand-by. Temporarily, by the development of a fall of 151 ft., it renders available a total of 260,000 h.p., while the ultimate achievement of the Shipshaw project, with its comprehensive fall of 205 ft., will raise the total to a million h.p.

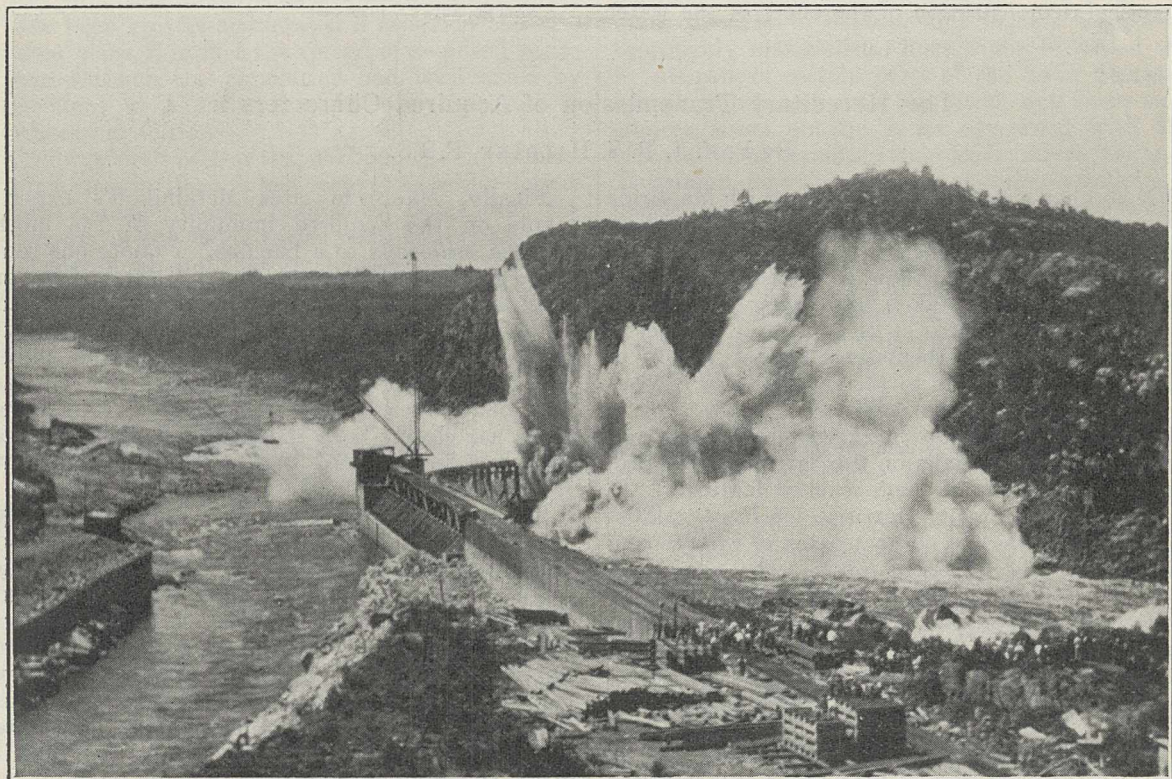


FIG. 2.—Damming the main stream of the Saguenay River. By courtesy of the High Commissioner of Canada.

at the head of the same river, has previously been noticed in NATURE.<sup>2</sup> The Isle Maligne installation is the property of the Quebec Development Company, and has a capacity of 540,000 horse power. Completed some five years ago, it represents the exploitation of about one-third of the total fall of the Saguenay River below Lake St. John, that is to say, from 90 ft. to 119.5 ft., according to the water level of the lake. In the original programme of development for the river, it had been contemplated that the remaining 208 ft. of fall would be developed in a single step, with an initial capacity of 800,000 h.p., and an ultimate capacity of 1,000,000 h.p. The delay involved in the single-step programme made it desirable, on economical grounds, to take advantage of a combination of natural conditions which permitted of more convenient development in two steps. The first of these is the Chute à Caron undertaking, and the

One of the most remarkable features\* of the undertaking, probably unique in engineering practice, was the instantaneous damming of the main stream, which is about 100 ft. wide by 35 ft. deep, by means of the fall of a monster block, or monolith, of solid reinforced concrete, weighing 10,950 tons. The 'obelisk', as it was termed for convenience (Fig. 1), was built in a vertical position on a small rocky island connected to the south bank of the river by a coffer-dam. It had a height of 92 ft., a width of 45 ft., and a depth of 40 ft. at the centre to the underside of its curved base. It contained 5400 cubic yards of concrete and 50 tons of steel reinforcement. The pedestal on which it was poised before its overturn, was made in the form of two piers, the smaller of which, on the river

\* The particulars relating hereto are taken from an extract of a paper read by Mr. J. W. Rickey, before the Engineer Society of Western Pennsylvania, and published in the *Canadian Engineer* of Jan. 26, 1932.



side, was, at a prearranged moment, demolished by blasting, allowing the unbalanced obelisk to roll forward over the cylindrical surface of the remaining pedestal and fall prone into the torrent, in this way completely arresting in a few seconds a volume of nearly 2000 cubic feet of water racing at a velocity of about 30 ft. per sec. A view of the incident is given in Fig. 2.

An operation of so unprecedented a character involved certain intricate problems, the calculated solutions of which were checked by the construction of a model to a scale of 1/50 in the Hydraulic Laboratory of the Carnegie Institute of Technology, Pittsburgh. Recording devices on the model gave practical demonstration of the effect of the water

cushion on the impact, and of the dynamic stroke of the stream against the obelisk before reaching the bed. It is satisfactory to learn that the whole operation of overturning the huge mass was carried through without a hitch of any kind. After the explosion of the charge of dynamite, the obelisk fell exactly in accordance with the calculations, and landed on the river bed within an inch of its destined position. The impact recorders showed that almost the whole (99.6 per cent) of the energy of the falling mass was absorbed by the cushion provided by the water.

<sup>1</sup> Hydro-electric Progress in Canada in 1931; Report No. 1571. Water Power Resources of Canada; Report No. 1573.

<sup>2</sup> NATURE, July 27, 1929.

## The Hereditary Transmission of Acquired Characters\*

By Prof. J. B. S. HALDANE, F.R.S.

IN another series of experiments which MacBride quotes, Harrison induced a race of the willow gallfly, *Pontania salicis*, to change its food plant from one species of willow to another. He first showed that a race taken from *Salix phylicifolia*, when given the choice of 21 species or subspecies of willow, confined themselves almost wholly to the original plant and to the related *Salix Andersoniana*. However, in addition, 3.5 per cent of the eggs were laid on *Salix rubra*. In two out of three years the galls on this latter plant failed. In one year seven of them reached maturity. In a second experiment, Harrison let loose gallflies from *Salix Andersoniana* in a patch of willows consisting entirely of *Salix rubra*. The eggs were perforce laid on the latter, and the large majority of the galls aborted in the first two years, but fewer in the next two. At the end of the fourth year, *Salix Andersoniana* was planted near the patch, but in the course of two years no galls were formed on it.

There can be no question of the importance of Harrison's demonstration that a race of insects can in this way acquire a new character. But the reasons for this event are not so clear. Wheeler (who as a Lamarckian cannot be accused of bias) regards the choice of food in which to lay eggs as determined largely by memory of larval surroundings, and particularly smells. The other factor in successful colonisation is the ability of the larva to eat and digest its food. Now, as in the first years most of the galls aborted, it would seem likely that the larvæ were being very stringently selected. The capacity to grow on *Salix rubra* is rare in the original race. Only in 7 out of 57 galls on it did the larvæ mature. Until a definite proof of Lamarckian inheritance has been given, in any case, we are justified in putting down the observed facts to selection, perhaps aided by individual (not racial) memory. We know that variation occurs in man with regard to idiosyncrasy to foodstuffs, and there is evidence that it is inherited; the same is very probably true of insects.

Finally, MacBride cites Metalnikoff's experiments on the acquired immunity of the moth *Galleria mellonella* to a bacillus. I quote one sentence from MacBride's account: "After three or four days the survivors were counted and allowed to develop and become the parents of the next generation". Unless *Galleria*, unlike men, mice, and other species investigated, does not possess any innate variability in its resistance to disease, there has clearly been stringent selection, and we need not be surprised that a relatively resistant race has been developed.

I pass over several other cases where apparently Lamarckian effects have been due to infection, and Kammerer's experiments, which terminated in his suicide, to the very remarkable results obtained by McDougall on rats. Unlike the other workers here cited, he began with an approximately pure line of rats which had been inbred for many generations. He also took considerable precautions to avoid selection. Unfortunately, the procedure of training was twice changed during the experiment, so I shall only describe the latter half.

The rats at an age between three and four weeks were dropped into a tank of water in which two turnings led to platforms covered with wire gauze by which they could emerge. One of these (alternately on the right and left) was illuminated, and a rat stepping out of the water on to it received an electric shock. Each rat was dropped in six times daily until it learned to avoid the illuminated platform. Learning was regarded as complete when this occurred on twelve successive trials. After twelve generations, all but one of which had been trained under slightly different conditions, but had shown a decided increase in educability, the procedure was finally standardised. In nine generations the average number of errors fell from 80 to 25, and the number made by the best rat from 42 to 3. In an experiment on a related group, the number of errors fell from about 170 in the first generation to 114 in the fifth. Finally, the worst performers were selected during two generations, but in spite of this, the time needed for training fell.

\* Continued from p. 819.



To obviate the possibility of tradition, mothers of a slightly trained stock were mated first with slow-learning and then with quick-learning males. The first mating gave an average number of 166 errors, the second of 62. The character acquired appears to be caution. It does not seem to be general intelligence, general timidity, or a specific fear of the bright gangway.

One very important point which emerged was that the progeny of the trained rats at first showed much greater variation in learning power than those of the untrained. If capacity for learning is inherited within the group (which could be ascertained or disproved from McDougall's records were they published in full), the process of change would have been greatly accelerated if selection had also taken place, if in fact the spread of acquired variations through the population had been aided by selection, as Darwin thought was the case in ordinary evolution.

Now, while it is clear that McDougall's experiment is in a class by itself, it has been criticised by Sonneborn, among others. Sonneborn notes that the intensity of the shock varied considerably and was not measured, and that McDougall found that rats subjected to light shocks took nearly three times as long to learn as when the shocks were heavy. So a progressive increase in the shock intensity could account for McDougall's results. He further points out that, if the method of choosing two rats 'at random' from a litter was to take the first two available in a cage, this would tend to select rats of a particular psychological disposition. Various other criticisms can be made. Hence it would seem that, while one must admit that McDougall has made out a *prima facie* case, a suspension of judgment is not unreasonable before we regard him as having demonstrated a principle in evolution which is unsupported by other evidence of the same calibre. It is, moreover, worth noting that in another experiment, broken off after four generations, McDougall found that the time needed for training increased in successive generations. He put this down to an increase in timidity, thus contriving to eat his cake and have it.

If we reject Lamarckism, we are, I think, left in the position termed neo-Darwinian, but concisely stated by Lucretius, one of the greatest minds of all history, two thousand years ago (I owe the quotation to Dr. C. D. Darlington)\*. Genes, the *genitalia corpora* of Lucretius, reproduce themselves at each cell division, and are handed down from parent to offspring. The genes in an organism determine how it will develop and behave in a given environment. The process of reproduction

\* The quotation from Lamarck is a moderate statement of his doctrine. He sometimes stated it in an obviously false manner; for example, in his "Histoire naturelle des animaux sans vertèbres" we read:

"Quatrième loi. Tout ce qui a été acquis, tracé, ou changé dans l'organisation des individus, pendant le cours de leur vie, est conservé par la génération et transmis aux nouveaux individus qui proviennent de ceux qui ont éprouvé ces changements."

For example, children acquire a full knowledge of their parents' language without education, and Jews are born circumcised! Lamarck's mistaken views on heredity do not, of course, lessen the greatness of his work on evolution. But it is unfortunate that many French biologists tend to exalt Lamarck and neglect another great Frenchman, de Vilmorin, whose discovery of pure lines laid the foundation of modern genetics.

of the gene is not perfect. Occasionally a gene produces another gene of a different type. This process is called mutation, and has never been shown to be adaptive, still less to perpetuate an acquired habit. Changes in the number of genes (for example, by doubling the chromosome number) also occur. Evolution is due to the fact that only a few of the possible combinations of genes survive. Were this not so, it would have been a mere orgy of variations without any particular trend.

I should like emphatically to protest against the view that the contest between Lamarckism and neo-Darwinism has anything to do with that between vitalism and mechanism. It would be quite possible to explain McDougall's results on thoroughly materialistic lines if the increased use by his rats of certain parts of the brain liberated specific substances into the blood, and these substances acted on the genes concerned with the elaboration of cerebral structure. Again, the neo-Darwinian may be a thorough-going vitalist, regarding each gene as an elementary living thing, contributing to the communal life of the cell and the federal life of the organism. He differs from the Lamarckian in believing that the gene has a very high degree of autonomy. There is no more reason to describe him as a mechanist than to dub a man an anarchist if he thinks that Parliament should not reverse the decisions of the London County Council. Similarly, a Lamarckian can be a vitalist, and a Darwinian a mechanist; or, like myself, he may refuse to take either point of view.

Further, it is often stated that a refusal to admit that conscious purpose has played any important part in evolution is a gloomy and even immoral point of view. McDougall writes of "the Cimmerian darkness in which Neo-Darwinism finds itself", and I admit that a theory which (like that of stellar structure) is largely based on integral equations is inevitably lacking in popular appeal. Nevertheless, the exact opposite seems to me to be the case. It has taken about a thousand million years for evolution to produce man, and the process has not only been slow but also often cruel. If mind had been an important evolutionary agent, there would be some ground for pessimism. If, on the other hand, it is only in our own time that the purposive guidance of the evolutionary process is becoming possible, then the outlook is altogether brighter. But if this is so, it is all the more our duty to examine as critically as possible the various evolutionary theories and to reject those which do not rest on a solid basis of observation.

From the human point of view the implications of the neo-Darwinian point of view were forcibly stated by the prophet Ezekiel (ch. 18, v. 2):

"What mean ye, that ye use this proverb concerning the land of Israel, saying, The fathers have eaten sour grapes, and the children's teeth are set on edge? As I live, saith the Lord God, ye shall not have occasion any more to use this proverb in Israel."

If we accept this point of view, each of us starts



afresh with the genetical constitution derived from his or her parents. The way in which his ancestors have employed their talents is irrelevant. The slum child, if of sound constitution, will not be handicapped by the bad environment of his parents provided he is transplanted early enough. Nor,

on the other hand, are the effects of university education inherited. By the process of death and reproduction the species throws off some of the intolerable burden of the past. Evolution is thus possible for the race at a rate and to an extent which would be impossible for the individual.

### Electrical Conductivity of Metals at the Lowest Temperature\*

WITH the fairly large supplies of helium now available it is comparatively easy by the liquefaction of this gas to reach temperatures so low as  $1^\circ \text{K.}$  ( $-272^\circ \text{C.}$ ). At this low temperature a few of the metals become perfect conductors of electricity. Most of them, however, still exhibit, when so cooled, a decreasingly small but still quite measurable resistance to the passage of a current.

In 1911, Kamerlingh Onnes at Leyden, while carrying out researches at low temperatures with the aid of liquefied helium, discovered that mercury, when cooled down and solidified with liquid helium, suddenly and abruptly at about  $4.2^\circ \text{K.}$  became what is now designated as a superconductor of electricity. At temperatures below  $4.2^\circ \text{K.}$  mercury offers no measurable resistance to the passage of a current. Currents of electricity started in a ring of mercury in the superconducting state will continue apparently undiminished in intensity while the metal is in that state. The duration of these persistent induced ring currents is limited only by the length of time the cooling agent, liquid helium, will last. Other metals that exhibit this superconducting property if made sufficiently cold are lead, tin, indium, gallium, thallium, tantalum, titanium, and niobium.

The transition temperature for the passing of a metal from the ordinary conducting to the superconducting state is not a constant but varies with the metal. For mercury it is  $4.2^\circ \text{K.}$ , for lead  $7.2^\circ \text{K.}$ , tin  $3.72^\circ \text{K.}$ , tantalum  $4.5^\circ \text{K.}$ , thallium  $2.39^\circ \text{K.}$ , indium  $3.4^\circ \text{K.}$ , gallium  $1.07^\circ \text{K.}$ , and niobium  $8.2^\circ \text{K.}$  Some alloys and chemical compounds of the metals also exhibit the superconducting phenomenon. Copper sulphide, for example, does so, though neither of the constituent elements is a superconductor. The nitrides and carbides, borides and silicides of several of the metals, such, for example, as molybdenum, tungsten, tantalum, zirconium, and niobium, are also superconducting at sufficiently low temperatures.

The addition of metals of the bismuth group to superconducting metals has been found, speaking generally, to raise their transition temperature. Bismuth added to lead raises the transition temperature from  $7.2^\circ \text{K.}$  to  $8.8^\circ \text{K.}$ ; carbon raises that of niobium from  $8.2^\circ \text{K.}$  to  $10.5^\circ \text{K.}$  Gold alloyed with bismuth becomes superconducting at  $1.94^\circ \text{K.}$ , whereas neither constituent alone becomes superconducting even at the lowest temperatures obtainable.

The application of mechanical stresses such as

those of torsion and tension raise the transition temperature of a superconducting metal, but the application of a magnetic field delays the appearance of superconductivity in a metal, and causes it to appear at a lower temperature than normally.

If a metal in the superconducting state be subjected to a gradually increasing magnetic field, a critical field strength is reached when electrical resistance reappears in the metal. The strengths of the critical fields required for different superconductors vary; an alloy of bismuth and lead, for example, at  $1.2^\circ \text{K.}$  requires a magnetic field of 20,000 gauss to restore the property of electrical resistance, while metallic thallium at the same temperature requires a field of only 15 gauss.

Since the electrical resistance of superconducting metals is zero, no heat is produced when electrical currents are passed through them. Currents of high intensity can therefore be passed through superconducting wires of small diameter without melting them. Electric currents of more than 1000 amperes have been so obtained in wires of small cross-section. The factor that imposes a limiting value upon the current strength is the magnetic field set up in the wire by the current itself. A critical value is reached when resistance is restored to the wire by the magnetic field.

Interest in the problem of superconductivity in metals recently received a stimulus through the discovery by Prof. McLennan and his collaborators that the transition temperatures with alternating electric fields applied are not the same for superconducting metals as when direct currents are passed through them. In a series of experiments with a coil of tin wire, drawn to a diameter of 0.3 mm., it was found that with direct currents the resistance of the coil began to decrease abruptly at  $3.76^\circ \text{K.}$  and disappeared completely at  $3.70^\circ \text{K.}$  Experiments with the same coil with currents of frequency  $1.1 \times 10^7$  per second gave for the corresponding temperatures  $3.67^\circ \text{K.}$  and  $3.61^\circ \text{K.}$ ; that is, superconductivity did not begin to appear until a temperature was reached that was below the one at which it was complete in the case of the direct current experiments. Further experiments with higher frequencies revealed depressions of the critical transition temperature, increasing in amount with the frequency. Extrapolation of the transition temperature-frequency curve, which appeared to be linear for the higher frequencies, gave  $10^9$  per second for the frequency corresponding to  $0^\circ \text{K.}$

With tantalum wires, results were obtained similar in character to those found with wires of tin and of lead. Experiments with tin wire coils

\* Substance of the Friday evening discourse delivered by Prof. J. C. McLennan, F.R.S., at the Royal Institution on June 3.



showed that the observed depression of the critical temperature was not dependent upon the magnitude of the high frequency currents in the coils, and was therefore attributable neither to the heating of the coils above the temperature of the surrounding liquid helium nor to the effect of the magnetic field of the currents. Experiments with wires of different sizes made with currents of the same frequency showed that the depression of the transition temperature was not a direct function of the skin effect. It would appear, then, to be a function of the frequency of the current in the metal alone.

The conclusion is drawn that polarisation and orientation phenomena are involved in the production of the superconducting state in metals, and that this electrical state is somewhat analogous to the saturated magnetic state obtainable with ferromagnetic metals. A new road of attack upon the problem of superconduction in metals seems to be opened up by the discovery of this frequency disturbance of the critical transition temperatures.

In the course of his lecture, Prof. McLennan gave

a demonstration of the persistence of an electrical current in a metal at the temperature of liquid helium. Prof. W. H. Keesom, who succeeded Kamerlingh Onnes at the Cryogenic Laboratory at Leyden, liquefied a quantity of helium during the morning of June 3. This helium was collected in a large Dewar flask supported in a second Dewar flask filled with liquid air; these two were then supported in a third Dewar flask also filled with liquid air. A small ring of lead about an inch in diameter and about an eighth of an inch in cross section was placed in the bottom of the inner flask immersed in the liquid helium and a current of several hundred amperes was induced by an external magnetic field in this lead ring. Prof. Keesom's assistant, Mr. Flim, carrying the Dewar flasks, was brought by aeroplane by Colonel the Master of Sempill to the aerodrome at Hanworth and thence by motor car to the Royal Institution in time for Prof. McLennan's discourse. By this means, liquid helium and an electric current in a superconducting metal were exhibited for the first time in England.

### Obituary

THE HON. MRS. HUIA ONSLOW

MRS. ONSLOW was a distinguished plant biochemist. As Muriel Wheldale, she went to Newnham College, Cambridge, in 1900, from King Edward's School, Birmingham, and in due course obtained a first class in Parts I. and II. of the Natural Sciences Tripos. She was appointed to a Bathurst Studentship in 1904, and afterwards became a research fellow and associate of her College. For two years she was a research worker at the John Innes Horticultural Institution. In 1926 she was appointed to a University lectureship in plant biochemistry at Cambridge.

Mrs. Onslow's scientific work was devoted mainly to two lines of inquiry: first, to the chemistry of anthocyanins, with special reference to the behaviour of these pigments in the genetics of flower colour; secondly, to the nature of the oxidase systems of plants. During the years 1903-9 she made a very thorough study of colour inheritance in *Antirrhinum majus*. As a result of this study she advanced the original suggestion that anthocyanins are formed from the glucosides of flavones; her view at that time being that the conversion was due to the action of an oxidase. In 1913-14 she isolated and studied chemically the antirrhinum pigments. This work was done before the classical studies of Willstätter were published, and though her views have not all been confirmed in detail, she was a pioneer in the subject, and in particular she was one of the first to discuss in acceptable terms the factors of inheritance from a chemical point of view.

To the study of plant oxidase systems Mrs. Onslow devoted much labour and made in particular one contribution of much interest. Bach and Chodat had shown that the tissues of some plants yield extracts capable of directly inducing certain oxidations such as the blueing of guaiacum, while

others do so only after the addition of a peroxide. The latter were held to contain a peroxidase enzyme alone, while the former contain a second factor capable of replacing the peroxide. Mrs. Onslow showed that this second factor is a catechol derivative, and found after an exhaustive study that it was present in all plants of the former class and absent in those of the latter. She then showed that plant extracts can convert monophenolic compounds, for example, *p*-cresol, into diphenolic compounds: an observation of importance to the later development of the subject. In recent years she was engaged in supervising an exhaustive research upon the respiration of apples, the work being done in relation with the problems of cold storage.

In 1916, Mrs. Onslow published a monograph on the anthocyanins, and in 1931 appeared Part I. of her "Principles of Plant Biochemistry". Of the latter, the second part is not published. Her last contribution was the review of the recent literature on anthocyanins which appeared in the issue of NATURE of April 23.

In 1919 she married the Hon. Huia Onslow, whose devotion to scientific and artistic labours after almost complete disablement by a serious accident won deep admiration from all who were privileged to know him. The companionship of one who shared his interests and understood his intellectual needs added happiness to his latest years.

Mrs. Onslow was deeply devoted to the subject of her study, and having a gift for clear exposition, she taught it with great success. She had a passionate love for travel, and of late years spent her holidays in exploring the more inaccessible parts of Central Europe. She leaves a widowed mother, whose sole companion she had been for a number of years.



## News and Views

## King's Birthday Honours

THE King's birthday honours list contains the names of the following scientific workers and others associated with scientific work:—*Viscount*: The Right Hon. Lord Buckmaster, chairman of the Governing Body of the Imperial College of Science and Technology. *Knights Bachelor*: Dr. H. B. Brackenbury, chairman of the Council of the British Medical Association; Mr. R. H. Davis, governing director of Messrs. Siebe Gorman and Co., Ltd., inventor of the Davis submarine escape apparatus and of a submersible decompression chamber for use in deep sea diving; Dr. Robert L. Mond, president of the Faraday Society and of the Egypt Exploration Society; Mr. MacPherson Robertson, for services in connexion with the Antarctic Research Expedition, 1929–31; Prof. W. Wright Smith, regius professor of botany in the University of Edinburgh, and regius keeper of the Royal Botanic Garden, Edinburgh. *C.B.*: Dr. C. V. Drysdale, director of scientific research, Admiralty. *C.S.I.*: Brev.-Col. F. P. Mackie, director of the Pasteur Institute and Medical Research Institute, Shillong, Assam. *C.M.G.*: Mr. H. E. Hurst, director-general of Physical Department, Ministry of Public Works, Egypt; Mr. F. A. Stockdale, agricultural adviser to the Secretary of State for the Colonies. *C.I.E.*: Mr. R. D. Richmond, chief conservator of forests, Madras. *C.B.E.*: Mr. A. W. Clapham, secretary of the Society of Antiquaries; Dr. Eleanor Constance Lodge, until recently principal of Westfield College, University of London; Mr. R. J. Reynolds, honorary adviser in radiology to the Ministry of Pensions; Prof. R. G. Stapledon, professor of agricultural botany, University College of Wales, Aberystwyth, and director of the Welsh Plant Breeding Association. *O.B.E.*: Mr. W. G. Fairweather, director of surveys, Northern Rhodesia; Mr. H. E. Flint, deputy conservator of forests, Burma; Mr. A. M. Henshaw, a member of the Safety in Mines Research Board; Mr. F. T. Morehead, deputy conservator of forests, Insein, Burma; Mr. H. B. Owen, medical superintendent and principal, Medical School, Mulago, Uganda Protectorate; Mr. G. Shearing, principal scientific officer, Naval Signal School, Portsmouth; Dr. H. C. Sinderson, dean of the Royal College of Medicine, and physician of the Royal Hospital, Ministry of the Interior, Iraq; Mr. C. W. Scott, forest economist to the Government of Burma; Major D. R. Thomas, chemical examiner to the Government of the Punjab; Mr. G. W. M. Woods, Indian Forest Service, Burma. *M.B.E.*: Mr. D. W. D'Silva, extra assistant conservator of Forests, Burma; Mr. O. E. C. Judd, deputy director of surveys, Bihar and Orissa; Mr. H. Kavanagh, timber assistant, Forest Department, Burma; Mr. A. Marshall, superintendent, Bacteriological Laboratories Section, Wellcome Tropical Research Laboratories, Khartoum. Mr. E. Muir, research worker in leprosy at the Calcutta School of Tropical Medicine and Hygiene, has been awarded a bar to his Kaiser-i-Hind medal.

## Honour for Sir Aurel Stein

IT is announced that the Council of the Royal Asiatic Society has awarded the gold medal of the Society "in recognition of distinguished services in Oriental Research" to Sir Aurel Stein, the well-known traveller and archæologist. For more than thirty years Sir Aurel Stein has been engaged in travel and exploration in Central Asia, with the authority and under the direction of H.M. Indian Government. His investigations among the sand-buried cities of Eastern Turkestan and Western China, where he shares with Sven Hedin the honour of pioneer exploration, have recovered for archæological and historical science a vast treasure of literary and official records, as well as of objects which reveal the art and culture of the early peoples of the Tarim basin. The remarkable achievements of their art in two directions in particular are demonstrated in two special publications dealing with this material—"Ancient Figured Silks Excavated . . . at Ruined Sites of Central Asia" (1920) and "Ancient Buddhist Paintings from the Caves of the Thousand Buddhas on the Westernmost Border of China" (1921). The results achieved in the journeys carried out by Sir Aurel Stein under the order of H.M. Indian Government have been described in a number of carefully prepared and scholarly publications, of which the best known are "Sand-buried Ruins of Khotan" (1907), "Explorations in Central Asia" (1906–8), "Ruins of Desert Cathay" (1912), and "Serindia" (1921), which for a travel book achieved the almost unique distinction of becoming a 'collector's book' saleable at a high premium within a short time of publication. In another field, "On Alexander's Track to the Indus" (1929) deals with exploration and topographical research in the lands of the Indian north-west frontier. Sir Aurel Stein received the honour of K.C.I.E. in 1912.

## Sir William Crookes (1832–1919)

ON June 17 occurs the centenary of the birth of Sir William Crookes, who was born in London in 1832 and died in Kensington on April 4, 1919, at the age of eighty-six. Save for a year or two, all his life was spent in London, and at his death he was buried in Brompton Cemetery. The son of a tailor, he was sent for a time to the Grammar School, Chippenham, but his scientific training began when at the age of sixteen he became a student under Prof. A. W. Hofmann at the Royal College of Chemistry. For four years he was one of Hofmann's assistants. He then spent a year as meteorologist at the Radcliffe Observatory, Oxford, and another as lecturer in chemistry at the Training College, Chester. At twenty-four years of age he married and returned to London, which henceforth became his home. Few men of science have had a more active or distinguished career than Crookes. For sixty years he was recognised as a most skilful experimenter, and he was likewise known for his intellectual independence and his wide interests. He first became well known through his



discovery in 1861 of the element thallium, a specimen of which was exhibited at the Hyde Park Exhibition of 1862. His subsequent researches extended to many branches of chemistry and physics, and his work often resulted in important applications of science to the arts and manufactures.

WHILE Crookes will probably be remembered longest for his researches on spectroscopy, on radiation, on the discharge of electricity in high vacua, and on the rare earths, much of his earlier work related to problems in practical chemistry. In 1859 he founded the *Chemical News*, of which he was editor until 1906, and his books included works on beet sugar, dyeing, metallurgy, manures, and similar subjects. In 1887 he served as president of the Chemical Society. Of the Royal Society he was a fellow for fifty-six years, being admitted F.R.S. in 1863, serving as foreign secretary from 1908 until 1912, and finally being elected president for the two years 1913 and 1914. He had already served as president of both the Institution of Electrical Engineers and the British Association, and it was in his address to the latter in 1898 he made his notable references to the problem of the world's wheat supply. Among his many distinctions were those of a place in the Paris Academy of Sciences, the honour of knighthood conferred on him by Queen Victoria in 1897, and the Order of Merit. There are portraits of him at the Royal Society and the National Portrait Gallery, his biography has been written by Dr. Fournier d'Albe, and an appreciation of his work by Prof. P. Zeeman, with a portrait, appeared in *NATURE* of Nov. 7, 1907, in our series of "Scientific Worthies".

#### Jubilee of St. Gothard Tunnel

ON June 1 the jubilee of the official opening of the St. Gothard Tunnel was marked by the unveiling by Signor Motta, President of the Swiss Confederation, of a sculpture entitled "The Victims of Work". This is a bronze casting of a sculpture made fifty years ago by the artist, Signor Vincenzo Vela, who intended it to decorate the entrance to the tunnel. The St. Gothard was the second of the five great alpine tunnels to be constructed, and it is the second longest. The first constructed was the Mont Cenis tunnel, driven by the engineers Sommeiller and Grattoni and opened in 1871. It is just over 8 miles long. The St. Gothard tunnel, constructed by Louis Favre (1826-79), who died in the tunnel of apoplexy, was begun in 1872, and is more than 9 miles long. The Arlberg tunnel through the Austrian alps, built a year or two after the St. Gothard, is  $6\frac{1}{2}$  miles long; the Simplon tunnel, opened in 1906, is  $12\frac{1}{2}$  miles long; and the Lötschberg tunnel, completed in 1911, is  $8\frac{1}{2}$  miles long. The St. Gothard tunnel connects northern and central Switzerland with Canton Ticino. Its northern opening is at Göschenen and its southern at Airolo; its central point is 3786 ft. above sea-level. The railway line from Zurich to Chiasso at the Italian frontier, which passes through the St. Gothard, was electrified about ten years ago, and trains cover the distance of 151 miles in 4 hr. 35 min.

#### Television Transmissions of the Derby

ON June 1 a television image of the Derby was shown at the Metropole Cinema, Westminster, to an overflowing audience. The television transmitter was situated on the racecourse adjacent to the winning post, and the audience at the Metropole were able to see the horses as they walked past the grand stand for the parade and again as they flashed past the winning post at the finish of the race. Vision was accompanied by a running commentary given by a commentator standing in the television caravan. The apparatus at the transmitter comprised a mirror drum revolving at 750 r.p.m. This revolving mirror drum casts a succession of images over three photo-electric cells, each of the mirrors of the drum being set at a slightly different angle from that of the preceding one, thus causing the image to be divided into a succession of strips. A drum with 30 mirrors was used, and the ratio of the picture for each photo-electric cell was 3 by 7, the picture received at the Metropole being constituted by three such pictures projected in three adjacent zones to form one composite image.

THE picture ratio was kept at 3 by 7 and the speed at  $12\frac{1}{2}$  so that the centre zone of the picture could be broadcast by the B.B.C., and this broadcast took place in the national programme simultaneously with the demonstration to the cinema audience. The receiver in the cinema comprised a mirror drum similar to that at the transmitter, three small arc lamps and three Kerr cells supplying the modulated light for the three zones. The image was projected on a translucent screen approximately 10 feet by 8 feet. During last week transmissions have been supplied from the Baird Studios in Long Acre on a single zone, and a number of representative people appeared before the television transmitter in Long Acre and addressed the audience at the Metropole from the television screen. Among those who appeared were Sir Ambrose Fleming, Sir Richard Gregory, and Sir Ian Hamilton.

#### World Production of Metals and Coal

THE speech recently delivered by Sir Robert Hadfield at the annual general meeting of Hadfield's, Ltd., gives some interesting statistics for the total production of gold and silver from 1493 to 1931, and of copper, iron, and coal from 1800 to 1931. The world's production of gold in these 438 years amounted to 32,500 long tons, valued at £5,100,000,000; for silver the corresponding figures are 397,000 tons and £2,900,000,000. For copper, iron, and coal the corresponding figures for the period 1800-1931 are 39,500,000, 2,895,000,000, and 52,000,000,000 tons and £2,200,000,000, £16,000,000,000, and £39,000,000,000. The comparative production is illustrated in a striking model prepared by Sir Robert Hadfield, which shows that the total production of gold in these periods would go in a cube of no more than 40 feet side, whereas silver would require a cube the side of which was 111 ft. long, copper 530 ft., iron 2360 ft., and coal 11,200 ft.



### The Gold Standard

Compared with that of other metals the production of gold is insignificant, and recent events which have demonstrated the defects in the gold standard and induced many nations to come off the gold standard have led many people to wonder whether gold is a suitable metal to be used as a standard at all. The diagrams and models prepared by Sir Robert Hadfield enable us to visualise more clearly the extent to which gold can now be merely a basis for currency. On the other hand, while the output of gold according to expert opinion shows a marked tendency to decrease, the increasing volume of the world's trade tends to augment the demand for gold as a basis for currency under our old systems of currency. In addition, the concentration of 75 per cent of the gold stocks of the world in the United States of America and France, where it is not used as the basis of so much money as in the countries from which it was withdrawn, has tended to accentuate the shortage. Without advocating a definite change or the adoption of bimetallism, Sir Robert suggested that the currency situation merited expert investigation and consideration by an authoritative international organisation such as the League of Nations. Certain reforms have in fact already been suggested by the League of Nations' Gold Delegation, and are outlined in a recent memorandum on "The Functioning of the Gold Standard", submitted by Dr. Feliks Mlynarski, which equally with Sir Robert Hadfield's speech will repay study not only by economists but also by those who are endeavouring to arrive at an intelligent view of the world's financial and economic situation.

### Return of the *William Scoresby*

THE Royal Research Ship *William Scoresby* reached London on June 6 after a commission of nineteen months in the service of the "Discovery Committee". On her arrival at the East India Docks she was inspected by Mr. E. R. Darnley, chairman of the committee, and by Vice-Admiral H. P. Douglas, who congratulated her personnel on the valuable scientific results which had been obtained. The work of the ship has been in the charge of Mr. E. R. Gunther as chief scientific officer, with Commander T. A. Jolliffe, R.N. (retd.), in executive command. After leaving England in November 1930, the *William Scoresby* was engaged for some months in oceanographic work on the whaling areas of the dependencies of the Falkland Islands, during which, with favourable ice conditions, observations were extended so far south as lat. 70°. During the southern winter of 1931 she was occupied in a survey of the Humboldt current on the west coast of South America, taking fifteen lines of stations at right angles to the coast, at each of which observations were made on the plankton and on the physical characteristics of the water at different depths. The lines of stations cover an area extending from Cape Carranza to Santa Elena, a distance of about 2200 miles, and it is already clear that the results will provide much new information on the current and on the wealth of animal life that it contains. More recently the ship has been employed in a third and

final survey of the trawling grounds lying between the Falkland Islands and the American coast. The survey was carried out with great thoroughness, and is expected to yield adequate data on the commercial possibilities of the area.

### Mexican Earthquake of June 3

AN earthquake of unusual severity occurred early on June 3 in the west of Mexico. The towns most seriously damaged, as known at the time of writing, are Colima and Guadalajara, which lie between 270 and 290 miles to the west of Mexico City. At Colima seventeen persons were killed, and at Guadalajara and in the surrounding district more than thirty. In the whole area, the number of lives lost is estimated at more than four hundred. Manzanillo, about twenty-five miles west of Colima and on the sea coast, is believed to have suffered more severely than either of the above cities, but all communications with it have been interrupted. In Mexico City, three violent shocks were felt, though the damage there was slight. According to the Mexican Seismological Bureau, the epicentre was 400 miles from the capital, and thus, as it lay in the direction of Colima and Manzanillo, it must be submarine, as in so many other recent Mexican earthquakes, but somewhat farther to the west. As in other earthquakes of the same country, the area of damage was of great extent, suggesting that the depth of the focus was considerable.

### Challenge to Witches in West Africa

THE sequel to the challenge to witches issued by the Christian Council of the Missions of West Africa (see NATURE, March 26, p. 464) was described by the Bishop of Accra at the fifth festival of the Accra Diocesan Association, held at Westminster on May 31. He recalled that the Council, in its desire to show that a great deal of West African witchcraft is nothing but fraud, had offered the sum of £10 to any witch who, in the presence of a representative of the council, should perform one of their favourite tricks, such as eat a papaw from a distance, remove an article from a locked box, or change a person into a bird, beast, or fish. Up to the time he left Accra some weeks ago, the only reply to the challenge had come from a wizard, who was unable to come to Accra, but offered, if the Council would go to him, to kill a man at a distance of forty miles. The Bishop hoped the challenge would be taken up, though not exactly in that form. The witches of Africa, he said, form a great secret society which is a source of harm to the people. The Europeans are outside a wall drawn around the native, as it were, and know very little about what goes on within.

### Guthrie Lecture of the Physical Society

THE seventeenth Guthrie Lecture to the Physical Society will be delivered on June 17 at 5 P.M. at the Imperial College of Science and Technology, South Kensington, by Dr. Max Planck, of Berlin, who will take as his subject "The Concept of Causality in Physics". Planck's greatest scientific achievements are the outcome of a study of thermodynamical principles and their multifarious applications. He was



thus led at the end of last century to the problems presented by full radiation, the last remaining problem of which, that of the energy distribution, he solved by formulating the quantum theory. The new feature in Planck's theory finds its expression in terms of the 'quantum of action', symbolised by the letter  $h$  (Planck's constant). This is a very small quantity, and the quantum theory consequently exhibits its special peculiarities only when applied to the small-scale phenomena for which it is needed. Applied to large-scale phenomena it coalesces, as it should do, with classical physical theory (in which we may include relativity). Planck's work has been creative in a higher sense than that of any of his contemporaries or predecessors, in that it has introduced, for the first time in the history of science, concepts that are really new.

#### Grasshopper Invasion in the United States

WE learn from Science Service, of Washington, D.C. (May 12), that a grasshopper invasion of exceptional severity is predicted to occur over the western United States. Field observations carried out over many years have shown that dry summers followed by relatively mild winters provide ideal conditions for these insects. The summer of 1930 was the driest on record, while that of 1931 was one of the hottest, as well as being a dry one. The past two winters have not been severe, and the consequence is that grasshoppers have become increasingly numerous in parts of the west. Last year, vast number of eggs were deposited in the ground, and now these eggs are hatching. The only possible control measure consists in the broadcasting of an arsenic-poisoned bran-mash bait, which the insects devour with avidity, and are killed thereby. The cost of its application over wide areas is large, and strong endeavours are being made to obtain funds from Congress that will enable the western farmer to apply this weapon in time to save his crops. Ample warning appears to have been given by entomologists, and others, with respect to what is described as the greatest grasshopper invasion of the past half-century, that is now threatening a large section of the country. It is obvious that only co-ordinated and very prompt action can alleviate the situation that is predicted to arise.

#### Celery Growing

IN view of the increase in consumption and production of celery in Great Britain, the Ministry of Agriculture has recently issued a new bulletin (No. 47) on celery growing (London: H.M. Stationery Office. 6d.), in which the cultural methods used by the specialist growers and the results of scientific investigations obtained by the Midland Agricultural College are described. At one time the chief celery-growing district was the Isle of Axholme, but it is now produced to a considerable extent in Lancashire, the Fens of Cambridgeshire, and Huntingdonshire. A good celery soil must be deep, though easily worked, and contain a high percentage of organic matter. The water supply must be plentiful, but good drainage is essential. Besides a heavy application of farm-yard manure, a dressing of superphosphate is recom-

mended prior to planting, while a top dressing of sulphate of ammonia is commonly given in July. The plants are raised from seed in hotbeds, and after being bedded out in small plots for about two months, are transferred to the field about June, this final planting being a highly skilled operation. The time at which the celery is lifted depends on the variety and nature of the soil, but it may be ready as early as the end of August. The question of the best methods of grading and trimming for the market is receiving attention. The avoidance of disease is of the utmost importance in celery growing. If entirely clean seed is not procurable, it should be treated with some disinfectant, such as weak formalin, before being sown, and further, spraying of the plants both in the beds and in the fields should be regarded as a routine operation if a successful crop is to be obtained. For further particulars of such treatments, readers are referred to *Bulletin 25*, where celery diseases and their control are dealt with in detail.

#### Early Man in Java

DETAILS of the discovery of another new type of man in Java a few months ago have now been published, as is noted by Prof. Elliot Smith in a letter to the *Times* of June 3. The discovery was made by Mr. C. Ter Haar, and the remains and circumstances of discovery are described by Mr. F. F. Oppenoorth, of the Geological Survey of Java, in the official publication of the Survey, issued at Batavia. In the course of the examination of the pliocene and pleistocene deposits of the Solo River valley, the greater part of a brain-case and two fragments of a second were found in a bone bed at Ngandong, more than twenty miles from Trinil, where Dr. Dubois found the remains of *Pithecanthropus erectus* in 1891. The fossil bones of fauna associated with the Ngandong find point to a mid-pleistocene age. The brain-case is described as of a more advanced type than *Pithecanthropus*, and to resemble more nearly Neanderthal man and the Rhodesian skull. It is, however, definitely more primitive than either and probably more ancient. The name suggested for this new species of the human family is *Homo soloensis*.

#### Criminal Anthropology

CRIMINAL anthropology, which for some time has suffered an eclipse owing to ill-judged claims which had little or no foundation on sound observation, is once more attracting the attention of investigators. In *Scientia* for May, Prof. A. Mendes-Corrêa recapitulates views which he has put forward from time to time on the contribution which a re-orientated anthropological method can make to the study of criminals and to practical measures in dealing with delinquents. The method advocated by the author is based on a study of the individual, whether normal or abnormal, in reference to his individual psychic and moral make-up and his biological and sociological conditions. Measurements, somatic characters, mental tests, and other methods employed in dealing with delinquents and defectives are regarded as auxiliary rather than as primary methods of investigation in criminological research. Prof. Mendes-Corrêa regards



the new criminal anthropology as a development of the Lombrosian methods which has shed the defects of that school. On the other hand, a preliminary study of the American criminal by Prof. E. A. Hooton, as reported by Science Service of Washington, more nearly approaches the methods of Lombroso, in that it endeavours to relate delinquency and physical type. Prof. Hooton's conclusions are, however, based on a large number of observations extending over a considerable period. He is of the opinion that his material justifies the conclusion that criminals in the totality of their physical characters differ from civilians of the same ethnic type. Certain variations of physical type tend to be associated disproportionately with certain types of crime.

#### Regenerative Braking on Trains

THE paper on tramway regeneration by G. H. Fletcher which was read to the Municipal Tramways and Transport Association, the last instalment of a reprint of which appears in the March issue of the *Metropolitan-Vickers Gazette*, is of great interest to tramway engineers. In regenerative braking, when the electric tram or train is going downhill, its own momentum drives the motors of the car as dynamos, thus absorbing energy and acting like a mechanical brake. It also converts the gravitational potential energy into electrical energy which is restored to the line, helping the power station, and thus leading to economical working. The advantages of the regenerative system are the reduced energy consumption and the reduced wear of brake shoes and wheel tyres, and the consequent lowering of maintenance costs. The disadvantages are that the motors are larger and more costly. There are many examples of remunerative regenerative braking abroad in mountain railways and on lines where the gradients are heavy. The Metropolitan-Vickers Company has equipped two sample tramcars on the Manchester and Glasgow corporation systems respectively with regenerative control. The equipment enables the kinetic energy of the train to be recovered and returned to the line instead of being dissipated in the brakes. The Manchester car has now been on service for some months and the Glasgow car has run several special trials. Both have worked very satisfactorily, effecting appreciable savings in power consumption. A specially equipped car was paired with a standard car and the two worked together for definite periods on a number of routes. The results show that the regenerative tram on an 8.5 miles per hour service on a comparatively flat route took twenty-seven per cent less power than the standard tram.

#### Annual Symposium on Colloid Chemistry

THE tenth annual Symposium on Colloid Chemistry will be held in Ottawa, Canada, on June 16-18. About two hundred workers in this field of science are expected to attend the meeting, and Mr. Emil Hatschek, lecturer on colloids at the Sir John Cass Technical Institute in London, will be the principal guest and speaker. He will read a technical

paper and will also give an evening lecture; the sessions will be held in the newly constructed National Research Laboratories. Papers will be presented on the colloid chemical aspects of such diverse subjects as: the constitution of rubber, by Thomas Midgley, of Columbus, Ohio; diphtheria toxins and antitoxins, by P. J. Moloney, of the Connaught Laboratories, Toronto; asphalts by Charles Mack, of the Imperial Oil Company at Sarnia; studies in cellulose, by O. Maass, of McGill University, Montreal; colloidal arsenic by E. F. Burton, of Toronto University; gelatin, by S. E. Sheppard, of the Eastman Kodak Company, Rochester, N.Y.; resins, by C. H. Winning, of the University of Wisconsin, Madison; cane wax in raw and refined sugar, by C. F. Bardorf, of the St. Lawrence Sugar Refineries, Montreal.

#### Committee on Slaughter-house Methods and Equipment

THE British Science Guild has appointed a Committee on Slaughter-house Methods and Equipment, "To verify and tabulate information relating to methods of, and equipment for, the slaughtering of animals for food, with especial reference to sanitary, dietetic, and humane requirements; to investigate new methods and equipment; to convey information on the subject to local authorities and other bodies and persons". The Committee consists of Lieut.-Col. Sir Arnold Wilson (chairman), Capt. C. W. Hume (vice-chairman), Mr. John McMath (honorary secretary), and the following members appointed on the recommendation of the bodies indicated: Mr. John Fearn (Institution of Mechanical Engineers); Dr. Charles Porter (Society of Medical Officers of Health); Sir James Douglas and Mr. R. Stephen Ayling (Model Abattoir Society); Prof. F. T. G. Hobday and Lieut.-Col. T. Dunlop Young (Royal College of Veterinary Surgeons); Mr. J. R. Hayhurst (Royal Sanitary Institute); Lieut.-Col. T. C. R. Moore and Mr. R. O. P. Paddison (Royal Society for the Prevention of Cruelty to Animals). The Medical Research Council has also been invited to recommend a member.

#### Birds in Inner London

A SHORT article in the May number of *British Birds* (p. 355) reveals unexpected variety of bird life in the heart of a great city. The presence of gulls has become commonplace, and it is not surprising that birds on migration should be heard passing overhead, like the curlews mentioned. But the settling of exhausted landrails and a woodcock, the appearance of young cuckoos in several gardens, of wheatears in Regent's Park, of a black-necked grebe in Kensington Gardens, a cormorant on the cross of St. Paul's Cathedral, and a pair of kestrels nesting in the belfry of St. Paul's School, Hammersmith Road—these are things which must have surprised and delighted the fortunate observers.

#### Bureau of Contraceptive Advice

A STATISTICAL analysis by Prof. Raymond Pearl on the year's operations of the Bureau for Contraceptive Advice, Baltimore, has been issued. During this, its



fourth year, 233 new cases attended the Bureau. All were married women, their average age was 30.44 years, and the average duration of marriage was 10.9 years—figures which refute some of the objections urged against contraception. Prof. Pearl considers that the Bureau has been in operation too short a time to make any definite report on the effectiveness of the advice given as to the technique of contraception.

#### Announcements

PROF. JACQUES HADAMARD (Paris), Prof. Graham Lusk (New York), Prof. Walther Nernst (Berlin), and Prof. Theobald Smith (Princeton) have been elected foreign members of the Royal Society.

M. LE DUC DE BROGLIE, who contributed to NATURE of May 7 the survey of Lord Rutherford's work which appeared in our series of "Scientific Worthies", has been elected an honorary member of the Cambridge Philosophical Society.

THE Council of the Chemical Society has awarded the Longstaff Medal for 1933 jointly to Prof. W. N. Haworth, of the University of Birmingham, and Sir James Irvine, of the University of St. Andrews, for their outstanding work on the chemistry of the sugars.

THE Joint Committee of the Royal Society of Edinburgh, the Royal Physical Society, and the Royal Scottish Geographical Society has awarded the Bruce Prize for the period 1930-32 to Mr. Herbert G. Watkins, for important contributions to the topography of Spitsbergen, Labrador, and East Greenland and investigation of the ice cap of Greenland. Mr. Watkins was leader of the Cambridge Expedition to Edge Island, Spitsbergen, 1927; leader of the Cambridge Expedition to Labrador, 1928-29; leader of the British Air Route Expedition to East Greenland, 1930-31; and will be leader of the projected expedition to Coats Land, 1932.

PROF. P. DEBYE, of Leipzig, has accepted the invitation of the Council of the Chemical Society to deliver the fifteenth Faraday Lecture on March 29, 1933.

SIR FREDERICK GOWLAND HOPKINS will open a discussion on "Recent Advances in the Study of Enzymes and their Action" to be held at the Royal Society on June 16. Other speakers will include Prof. R. Willstätter, of Munich; Prof. Waldschmidt-Leitz, of Prague; Dr. Richard Kuhn, of Heidelberg; Prof. A. Harden, Prof. J. B. S. Haldane, Dr. D. Keilin, and Dr. J. H. Quastel.

THE sixth Stephen Paget Memorial Lecture of the Research Defence Society will be delivered by Sir Arthur Keith at the annual general meeting of the Society to be held at the London School of Hygiene and Tropical Medicine on June 15 at 3 P.M. Sir Arthur will speak on "Some Aspects of the Modern Conflict between Reason and Sentiment".

MESSRS. Charles Baker, 244 High Holborn, London, W.C.1, have prepared a new issue (No. 101) of their classified list of second-hand scientific apparatus. Section 1, dealing with microscopes and their accessories, is very full and covers a wide range of makes

and equipment. There is also an extensive section on surveying instruments, and others on astronomical and physical apparatus generally. Surveying instruments can be hired, and lantern exhibitions are arranged.

"La Maison de la Chimie" which is being erected in Paris will constitute an important centre of chemical activities. Apart from several meeting halls, the largest of which will accommodate a thousand people, it will contain an extensive library with special means of documentation, including films and discs, and the latest technical improvements. The building of this centre has been made possible by an international subscription on the occasion of the centenary of Marcelin Berthelot, and the gift by the French Government of the old palace de la Rochefoucauld d'Estissac, which is being reconstructed and extended to make it suitable for its new function.

WE have received from Messrs. British Drug Houses, Ltd., Graham Street, London, N.1, a copy of "B.D.H. Reagents for Delicate Analysis and Spot Tests", which contains descriptions of several new reagents for the detection of substances with minute amounts of material. Many of the reagents are specific, so that it is now frequently possible to avoid group separations. In each case references to the original literature are given, so that the information is useful as an addition to analytical chemistry. The price of the book, which is well bound, is 2s. 6d.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A woman lecturer in geography at Bingley Training College—The Education Officer, County Hall, Wakefield (June 15). A radium officer for a National Radium Regional Centre at Southampton—The Secretary, Royal South Hants and Southampton Hospital, Southampton (June 18). A head of the commerce department of the Gamble Institute, St. Helens—The Secretary for Education, Education Office, St. Helens (June 20). A laboratory assistant at the Joint Counties Mental Hospital, Carmarthen—The Clerk to the Visitors, 34 Quay Street, Carmarthen (June 20). An assistant lecturer in mathematics in the University of Sheffield—The Registrar, University, Sheffield (June 21). An assistant lecturer in geology in the University of Birmingham—The Secretary, University, Birmingham (June 23). An assistant lecturer in metallurgy and assaying at the Manchester Municipal College of Technology—The Registrar, College of Technology, Manchester (June 30). A lecturer in mathematics in the Manchester Municipal College of Technology—The Registrar, College of Technology, Manchester (July 2). A resident lecturer for biology and some mathematics at Stockwell Training College for Women—The Principal, Training College for Women, Stockwell, S.W.9. An assistant master, honours graduate in engineering, for the Day Technical and Commercial School, Westcliff-on-Sea—The Headmaster, Day Technical and Commercial School, Fairfax Drive, Westcliff-on-Sea.

ERRATUM.—NATURE, June 4, page 819, col. 2, lines 20-21, for *Pieris rapæ* read *Pieris napi*.



## Letters to the Editor

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

## Photochemistry of Vitamins A, B, C, D

FROM their letter in NATURE<sup>1</sup> and various reports in the daily Press, it would appear that the work of Drs. F. P. Bowden and C. P. Snow provides a new and powerful technique offering the prospect of an immediate extension of knowledge concerning vitamins. In scrutinising the evidence disclosed in favour of this claim, we find ourselves in difficulties. In the first place, the technique (the study of spectral absorption curves, and irradiation with light of selected wave-lengths) is familiar and has already been applied in vitamin studies; while in the second place, the idea of one experimental method as a key to several vitamins seems to underestimate the differences between organic compounds of widely varying constitution sharing only a capacity to induce unusual (but quite diverse) physiological responses. Drs. Bowden and Snow evoke two possibilities:

(1) The association of an absorption band with a vitamin on the basis of the disappearance of both activity and absorption as a result of irradiation with light of defined wave-lengths. Useful results on these lines have already been described for vitamin A in 1928.<sup>2</sup>

(2) That "When applied to a suitable pre-vitamin, monochromatic irradiation with light of the correct wave-length produces maximum yields of the vitamin". Apart from the ambiguous term "maximum yields", this statement is baldly true of existing knowledge concerning the ergosterol  $\rightarrow$  vitamin D transformation. The claim to have extended the idea of a photochemical precursor substance, by experiment, to other vitamins, is a recent departure first put forward by Rygh<sup>3</sup> in connexion with narcotine and vitamin C, and now again advanced by the authors in connexion with carotene and vitamin A. The work of Rygh has already been subjected to criticism,<sup>4</sup> and it is now necessary to consider the contribution of Drs. Bowden and Snow. In the case of vitamin D, an association with photochemistry is of long standing (light therapy, especially in relation to rickets), but with vitamin A the association is exclusively with a *metabolic* rather than a *photochemical* pre-vitamin. Having observed the presence in  $\beta$ -carotene of a band at 270  $m\mu$  (this band has previously been recorded),<sup>5</sup> the authors subjected a solution of  $\beta$ -carotene in cyclohexane to monochromatic irradiation (Hg 265  $m\mu$ , 253.7  $m\mu$ ) in an atmosphere of nitrogen. After a few hours a strong band appeared near 328  $m\mu$  and the resultant product was found to give a blue colour with antimony trichloride. From these results, pending biological experiments, a photochemical transformation of carotene into vitamin A is claimed.

Now, whereas the vitamin A of liver fat is a practically colourless alcohol (most probably  $C_{20}H_{30}O$   $\overline{I}$ ),<sup>6</sup> exhibiting near 328  $m\mu$  a band of defined intensity ( $E_{1\text{ cm}}^{1\%}$  1350) and giving a blue colour with antimony trichloride sharply differentiated ( $\lambda$  max. 617  $m\mu$ ) from the blue colour given by carotene ( $\lambda$  max. 585-590  $m\mu$ ),<sup>7</sup> the experiment of Bowden and Snow, properly executed, can only yield hydrocarbons. From the published spectrograms their product is obviously

coloured and in all probability contains unchanged carotene, so that the relevance of the promised biological assay does not emerge, since it has been fully established<sup>8</sup> that carotene is converted *in vivo* into vitamin A.

The one piece of concrete evidence is the recognition of a new maximum near 328  $m\mu$ . In this instance the authors are using the band as a criterion for a complex molecule, but elsewhere in their communication they refer to the diagnosis of absorbing groups. At the best, they have evidence of a product possessing a molecular grouping similar to that present in vitamin A, but they omit to deal with the obvious and more probable explanation, namely, a molecular rearrangement. Actually, we have observed here that *isocarotene*,<sup>9</sup> which is a coloured substance readily obtained from carotene in various ways, also possesses a sharp band near 320  $m\mu$ . The destruction of vitamin A by radiation within the 328  $m\mu$  band has already been fully demonstrated.<sup>9</sup>

*Vitamin B.*—The fact that a crystalline specimen of this vitamin exhibits absorption maxima at 260, 240, and 210  $m\mu$  is an interesting qualitative observation, the value of which for the diagnosis of structure remains to be demonstrated. For purposes of assay, the observation only becomes useful if it can be shown that the materials normally accompanying the vitamin are themselves much more transparent in the region 200-270  $m\mu$ . That irradiation (Hg 253.7  $m\mu$ ) destroys the vitamin and effects the disappearance of the 260  $m\mu$  band is in no sense surprising. If the material were pure, then obviously the other bands must equally be properties of the vitamin, and hence the claim that the physiological activity arises in some special sense from the part of the molecule giving rise to the 260  $m\mu$  band, far from being "fully established", is unjustified. Until the structure of the organic molecule is at least broadly established, this kind of interpretation of spectral absorption data is both uninformative and premature.

*Vitamin C.*—Drs. Bowden and Snow state that when they are able to record the absorption spectrum of pure vitamin C, they will be able to test its identity with either irradiated narcotine or hexuronic acid. This is so true as to be obvious, but the necessity for monochromatic irradiation does not emerge.

*Vitamin D.*—Here Drs. Bowden and Snow appear merely to have confirmed earlier observations, except as regards the sentence: "the spectroscopic evidence is, however, already sufficient to indicate that the conversion of ergosterol into calciferol depends on the migration of a double bond to a position in which its influence on the other double bonds is greatly enhanced" (our italics). We would inquire what the authors intend to convey by the italicised phrase. So far as the known absorption spectra of calciferol and ergosterol are concerned, the statement conveys no meaning whatever. No indication is given of any other criteria of 'enhanced influence', neither is it clear what is meant by the *elimination* of an absorbing group from a complex organic molecule by irradiation with light of related frequency. Before such considerations can be of much avail, it is essential to know exactly the nature of the absorbing group—and in most complex organic compounds, the present position of the interpretation of absorption spectra does not make this possible. In this connexion neither the origin of the ergosterol bands nor the calciferol band is yet understood. The possibility of a rearrangement of the double bonds of ergosterol has already been fully studied by Windaus<sup>10</sup> by strictly chemical methods.

In the case of vitamin A, the effective entity is possibly a system of four conjugated double bonds. We can understand a photochemical process breaking



up this system, but eliminating the group with "ease and certainty" has no precise meaning.

I. M. HEILBRON.  
R. A. MORTON.

Department of Chemistry,  
University, Liverpool,  
May 26.

- <sup>1</sup> Bowden and Snow, *NATURE*, **129**, 720, May 14, 1932.
- <sup>2</sup> Morton and Heilbron, *Biochem. J.*, **22**, 987; 1928.
- <sup>3</sup> Rygh and Rygh, *Z. physiol. Chem.*, **204**, 114; 1932.
- <sup>4</sup> Zilva, *J. Soc. Chem. Ind.*, **51**, 166; 1932.
- <sup>5</sup> Dullière, Morton, and Drummond, *J. Soc. Chem. Ind.*, **48**, 316T; 1928.
- <sup>6</sup> Karrer, Morf, and Schöpp, *Helv. Chim. Acta*, **14**, 1036; 1931; and *Helv. Chim. Acta*, **14**, 1431; 1931.
- <sup>7</sup> Heilbron, Heslop, Morton, Drummond, and Rea, *J. Soc. Chem. Ind.*, **51**, 164; 1932.
- <sup>8</sup> Moore, *Biochem. J.*, **23**, 803; 1929.
- <sup>9</sup> Gillam, Morton, Heilbron, and Drummond, *J. Soc. Chem. Ind.*, **51**, 164; 1932.
- <sup>10</sup> Windaus, *Proc. Roy. Soc.*, B, **108**, 568; 1931.

### Resistance of the Eggs of Collembola to Drought Conditions

THE activity and abundance of Collembola are closely associated with the moisture of their environment. The species *Sminthurus viridis* (L.) Lubb. occurs in large numbers in certain areas of South Australia during the rainy season (May to October). The numbers rapidly decrease when the dry season sets in and, normally, the insect does not occur again until about the following May.

Certain of the eggs remain dormant in the soil during the dry season. This condition is not due to a definite rhythmical diapause, but is enforced owing to the lack of moisture in the surface soil during this

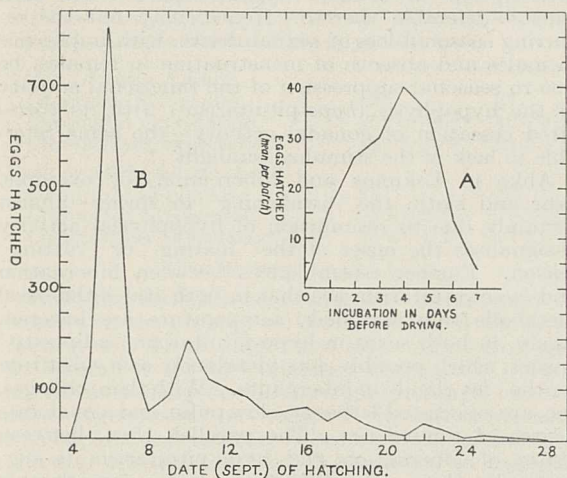


FIG. 1.

season. The eggs can be induced to hatch with suitable moisture and temperature.

During experimental work with this species, it was found that with egg batches, exposed to dry conditions for varying periods and then remoistened, the eggs commenced to hatch in a comparatively short time, showing that some development had taken place prior to being remoistened.

The stage of development attained by the eggs prior to the onset of dry conditions is an important factor affecting the number which survive a temporary drought period. 100 egg batches of *S. viridis*, estimated at 4500 eggs, were arranged in eight series (Series 7 to 0). The number of batches in each series was 18, 13, 14, 13, 14, 9, 8, 11. The batches were laid on moist soil contained in 2½-in. flower pots, the conditions being uniform. There were six pots in

each series, and the batches were retained, as laid, *in situ* on the soil, throughout the experiment.

With Series 7, the pots were placed in an incubator at 24° C. for 7 days from the date of being laid, the soil being kept suitably moist. With Series 6, the pots were 6 days in the incubator, and so on, with the remaining series to Series 0 with no days in the incubator. All the pots were then transferred to a heated glass-house on the same day (Aug. 15) and the soil allowed to dry out for 17 days. (Mean daily max. temp. 30° C., min. temp. 12° C. Mean daily relative humidity 56 per cent.) By Aug. 17 the moisture content of the surface soil, based on the moist soil, was 2.5 per cent. On Sept. 1, the soil in all the pots was remoistened and the daily hatching from each series was recorded. (During the period, Sept. 1-16, the mean daily max. temp. was 28° C., and mean min. temp. 11° C.)

A total of 2144 eggs hatched. The mean number of eggs per batch which hatched in each series is shown in Fig. 1, A, and the daily total of eggs which hatched from all the series is shown in Fig. 1, B. (In Series 7, 93 eggs hatched during Aug. 17-20. In Series 6, 86 eggs hatched during Aug. 18-20. These are not included.) I have discussed the normal incubation period elsewhere.<sup>1</sup>

The relative resistance of the egg at different stages appears to be associated with the changes occurring during development. In the advanced stages of the embryo, the egg swells and the chorion splits at the equator. Two polar caps are thus formed which gradually separate, revealing the embryo surrounded by a transparent membranous envelope.

Ripper<sup>2</sup> has described changes in the egg of *Hypogastrura* in this respect, which differ in detail from that of *S. viridis*.

JAMES DAVIDSON.

The Waite Institute,  
University of Adelaide,  
March 31.

- <sup>1</sup> *Australian J. Expt. Biol. and Med. Science*, **8**, 143; 1931.
- <sup>2</sup> *Z. angew. Entom.*, **16**, 559; 1930.

### Inheritance of Milking Capacity

IN replying to Mr. Buchanan Smith's remarks<sup>1</sup> concerning my discussion<sup>2</sup> of Mr. Madsen's letter,<sup>3</sup> I shall deal with them in the order set out by him.

(1) I suggested that the small correlation to the paternal granddam might be explained by the selection of the sires of bulls studied as prepotent on the basis of the progeny test (rather than on their dams' records), a form of reasoning used by Mr. Buchanan Smith for another purpose<sup>4</sup> in discussing a low correlation of daughters' yields to their paternal granddams' yields when he states "... this ... may probably be explained by the fact that up till quite recently in the Ayrshire breed the bull was selected not on the performance of his dam so much as on the show-yard record of his sire". In each case the principle is obviously the same—the bull being selected with little reference to his dam's record. Mr. Buchanan Smith's statement that "when the full paper is published Mr. Madsen will show that the majority of sires involved have not been selected on genotype but on appearance plus pedigree" is difficult to reconcile with Mr. Madsen's own statement about "... breeders who for the past 15 years have, through an intelligent appreciation of the progeny test, paid almost exclusive attention to the male line".

(2) Rather than to the contrary we find ourselves in agreement on the second point; I stated that a cow's record is insufficient in foretelling the production



of her progeny because it is the expression of a phenotype and Mr. Buchanan Smith allows that rarely is the cow's genotype capable of assessment because of the small numbers of her progeny. This is a state of affairs in no way improved upon by any increase in the number of daughter-dam pairs, and as in discerning inheritance it is essential to distinguish transmitting ability from actual production, it is difficult to see why two small correlations to phenotypes far removed can be expected to reveal anything. Actually the correlations amongst genotypes in Mr. Madsen's data should more reasonably be expected to yield a clue, as the X-chromosome which the bulls receive comes as often from the maternal grandsire as from the maternal granddam, though never from the paternal grandsire. Mr. Madsen finds that to the latter parent  $r=0.202$ , while to the maternal grandsire  $r=0.194$ , which would indicate that the presence or absence of the X-chromosome makes no difference.

The method of direct correlation employed leaves much to be desired. To a daughter's inheritance the sire and dam each contribute and yet in the daughter-dam correlations the sire's part is completely left out of account. This omission is not made good by an increase in the number of daughter-dam pairs studied.

(3) and (4) That the suggestion of inaccuracy in the calculation of the odds as one in ten is unfortunate is shown by Dr. J. Wishart in a letter contributed below.

I agree with Mr. Buchanan Smith that Mr. Madsen's investigation is particularly exhaustive and it is the very thoroughness with which he has prosecuted it which makes the likelihood of significant sex-linkage even more uncertain.

J. EDWARDS.

School of Agriculture,  
University of Cambridge.

<sup>1</sup> NATURE, 129, 688, May 7, 1932.

<sup>2</sup> NATURE, 129, 437, March 19, 1932.

<sup>3</sup> NATURE, 129, 165, Jan. 30, 1932.

<sup>4</sup> Smith, A. D. Buchanan, and Robison, O. J., "The Inheritance of Milk Yield". Conference Papers, Internat. Dairy Cong., Copenhagen, 1st section, pp. 127-140; 1931.

THE standard errors of the correlation coefficients 0.026 from 721 pairs and 0.112 from 715 pairs are almost exactly equal, at 0.037. Thus the difference 0.086 is 1.64 times its standard error, and treating this as a normal deviate it appears that a difference of this size, or greater, would occur in random samples from equally correlated populations just once in ten times on the average. Mr. Edwards used the more exact  $z$ -transformation of R. A. Fisher, but the small size of the correlations and the large numbers on which they are based, lead to exactly the same result by both methods. The observed coefficients are thus compatible with the hypothesis that the correlations with paternal and maternal granddam are equal. The best value for the joint correlation afforded by the data is 0.07, so that the relationship at best is very slight.

J. WISHART.

School of Agriculture,  
University of Cambridge.

#### Light and Sexual Periodicity

IN the North Greenland (Peary) Expedition, evidence of sexual periodicity in the Eskimos was observed by Cook.<sup>1</sup> Thus, with the onset of the sunless winter, sexual desire fails and menstruation during the long period of darkness is absent. But with the dawn of spring a phase of sexual excitement or proestrus ensues, menstruation returns, and the majority

of the children are born nine months after the return of the 'sun'. The girls marry at fourteen or fifteen years of age, but the menstrual flow does not begin until they are nineteen or twenty years old. Children are 'suckled' for four to six years, and on the average one child is born every four years. Stieve and others, too, have noted that in the long polar night Eskimo women neither menstruate nor conceive. If this *hiatus* in the sexual cycle be due to absence of light, it must be of 'sunlight', for moonlight is present in the polar night. Light and heat rays seem essential for maintenance of the sexual cycle.

This annual recurrence of a 'menopause' suggests a species of 'hibernation' localised to the hypophysio-gonadal system, and that it should be so restricted and not generalised is presumably due to the fact that they—unlike warm-blooded hibernants—have no 'fat gland' to draw upon during the long winter sleep. Hence the need of fat consumption, and body temperature stabilisation forbids such marked slowing down of tissue metabolism, pulse, and respiration—with consequent induction of sleep, oliguria, and poikilothermia—as occurs in true hibernants which pass the winter in a state of retarded animation.

This assumption of localised hibernation of the hypophysio-gonadal system recalls the many similarities obtaining between generalised hibernation and pituitary (anterior hypophysis) dysfunction. In hyper-pituitarism (acromegaly) sexual desire is increased, but in *hypo*-pituitarism abolished—males become impotent, and in females menstruation ceases. This correlated variation of pituitary (hypophysial) with gonadal functional activity indicates that the sexual cycle is controlled by the hypophysis and any interruption in sexual rhythm—apart from local causes—referable thereto. Hence, may not the recurring seasonal loss of sexual desire, with impotence in males and absence of menstruation in females, be due to seasonal suppression of the functional activity of the hypophysis (*hypo*-pituitarism) with its correlated cessation of gonadal activity—the same referable to lack of the stimulus 'sunlight'?

Alike in Eskimos and hibernants, for example, bear and sloth, the 'awakening' in spring—almost certainly due to resumption of hypophysial activity—signals the onset of the 'mating' or 'rutting' season. Further resemblances between hibernation and *hypo*-pituitarism are that in both states the basal metabolic rate and body temperature are lowered. Again, in both sexes in *hypo*-pituitarism 'adiposity' ensues, which possibly acts vicariously as a substitute for the 'fat gland' of hibernants. With these changes, too, are associated lethargy, slow pulse, and a moderate degree of somnolence. The parallel, then, between states of hibernation and *hypo*-pituitarism is suggestively close—the differences being quantitative rather than qualitative.

It has been suggested that the sexual periodicity in Eskimos is a racial peculiarity. But Cook—in alluding to the suppression of sexual desire and menstruation with "great muscular debility" in Eskimos—observes, "Our own party suffered in the same way". Their participation would seem to rule out any question of its being a racial peculiarity, indicating rather that *all* persons, when living in the arctic zone, react in like fashion to long-continued absence of 'sunlight'. As to the pathway of light transmission, that of vision first presents itself, and possibly light mediated through the hypophysis in this way influences the sex organs.

LL. J. LLEWELLYN.

Athenæum, S.W.1.

<sup>1</sup> F. Cook, *New York Journal of Gynecology and Obstetrics*, 1894.



Chromatid Segregation in Tetraploid *Rubus*

IN *Rubus rusticanus* an unprickled variety *inermis* occurs. The character behaves as a recessive in reciprocal crosses with the normal type. In 1927,<sup>1</sup> we showed how this character was inherited in tetraploid forms. A tetraploid seedling 'RT4' was raised from the cross *R. rusticanus inermis* ♀ ( $n=7$ ) by the tetraploid prickled species *R. thyrsiger* ♂ ( $n=14$ ); the female parent had given an unreduced egg with 14 chromosomes, which was fertilised by normal pollen of *R. thyrsiger*, also with 14 chromosomes. The constitution of RT4 in regard to the *inermis* character was, therefore, *AAaa*. With random segregation amongst four chromosomes (considered by Muller in 1915) it should have given a 35:1 ratio of prickled to unprickled. With regular segregation of *A* from *a* (allosyndesis) it should have given a 15:1 ratio. The proportion found was intermediate (471:19) and we considered therefore that randomness was modified in the direction of allosyndesis—an improbable but, as it then seemed, an inevitable explanation.

Haldane<sup>2</sup> has applied the principle of chromatid segregation to polyploids. This principle was first demonstrated in polyploid *Drosophila* and agrees with the simplified chiasmotype hypothesis of crossing-over. The ratios expected with random chromatid segregation in a tetraploid of the constitution *AAaa* are 20.78:1 (187:9) instead of 35:1, and in the backcross to *aaaa* 3.67:1 (11:3) instead of 5:1. The following table shows the comparison of new results obtained in the last five years with the two alternative expectations of random segregation of chromosomes and chromatids. (The possibility of allosyndesis need not now be considered.) The results agree closely with the chromatid expectation and differ significantly from the simple chromosome expectation.

	Prickles.	No Prickles.
Selfed ( <i>AAaa</i> × <i>AAaa</i> )		
Observed (872 plants)	835	37
Chromatid expectation	$832.0 \pm 6.2^*$	$40 \pm 6.2$
Chromosome expectation	$847.8 \pm 4.9$	$24.2 \pm 4.9$
Back-crossed ( <i>AAaa</i> × <i>aaaa</i> )		
Observed (43 plants)	33	10
Chromatid expectation	$33.8 \pm 2.7$	$9.2 \pm 2.7$
Chromosome expectation	$35.8 \pm 2.4$	$7.2 \pm 2.4$

\* Standard error,  $\sigma = \sqrt{p(1-p)}$ .

Blakeslee and his collaborators<sup>3</sup> have found recessives in the progeny of *AAAA* plants of tetraploid *Datura*, and *AAaa* plants also show ratios that may be accounted for by chromatid segregation. These are the only sharp deviations from the simple chromosome segregation yet observed in autotetraploids. The explanation is clear. Chromatids from the same parental chromosome have been shown to segregate together at the spindle attachment, both where chromatid segregation has been shown genetically<sup>4</sup> and where crossing-over has been proved cytologically.<sup>5</sup> Random chromatid segregation will therefore only be expected with factors having 50 per cent of observed crossing-over between them and the spindle attachment, a value which under most conditions is only approached asymptotically.

Observations of inheritance in tetraploids therefore confirm expectation based on general cytological and genetical observation, and particularly agree with the chiasmotype hypothesis of crossing-over.

M. B. CRANE.

C. D. DARLINGTON.

John Innes Horticultural Institution,  
London, S.W.19, April 28.

<sup>1</sup> *Genetica*, 9.

<sup>2</sup> *J. Genet.*, 22; 1931.

<sup>3</sup> *Bot. Gaz.*, 76; 1923.

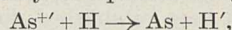
<sup>4</sup> E. G. Anderson, *Genetics*, 10; 1925.

<sup>5</sup> Darlington, *Proc. Roy. Soc.*, B, 107; 1930. *J. Genet.*, 24; 1931.

## Resonance Spectrum of Hydrogen

It was reported in a previous communication<sup>1</sup> that, in the course of experiments by Dr. J. S. Badami and me on the spectrum of arsenic by the Paschen hollow cathode discharge in helium, the Lyman series of hydrogen was obtained with remarkable strength, the important feature of the series being the curious intensity anomaly exhibited by the members. Instead of the intensity gradually falling off, a sudden enhancement was observed in that of the 10th and the 11th members ( $\nu 108,771$  and  $108,916$ ). Experiments under varying conditions indicated definitely that this intensity anomaly occurs only in the presence of arsenic. The suggestion was made that the energy of excitation of this resonance spectrum is to be sought for in a transfer, by collisions of the second kind, from the excited arsenic atoms. Since sending this report, values of the characteristic energy levels of the neutral and ionised atom of arsenic<sup>2</sup> have become available, and a consideration of these has confirmed the above explanation.

The reaction may be represented by the equation:



where  $\text{As}^{+'}$  represents an arsenic ion in an excited metastable state. The existence of such states, formed by collisions of the second kind with excited rare gas atoms or ions, in the source employed, can be easily supposed from the experiments of various investigators on this method of discharge. The excitation energy of the enhanced 11th member of the hydrogen series is 13.44 volts, and the energy corresponding to a transition of the excited arsenic ion in the metastable state  $4p \ ^1S_0$  to the normal state  $4p \ ^4S_2$  of the neutral atom (that is,  $\text{As}^{+'} \rightarrow \text{As}$ ) is found equal to the above value within the limits of error involved in the estimate of the first ionisation potential of arsenic.

The phenomenon appears to be analogous to the observations made by Beutler and Josephy,<sup>3</sup> where a mixture of the vapours of sodium and mercury and a foreign gas was excited by mercury radiation  $\lambda 2537$ ; and the lines  $2P - 5S$  and  $2P - 7S$  of sodium appeared with great intensity, the excitation energy of these lines corresponding closely to the energy of the excited states  $2 \ ^3P_1$  and  $2 \ ^3P_0$  of mercury. It is to be noticed that a close 'resonance' between the two colliding partners is of importance for this transfer of energy.

If the above interpretation of the phenomenon is accepted, we meet here with a type of collision which, so far as I am aware, has not hitherto been observed. We have evidence<sup>4</sup> of a simultaneous ionisation and excitation by collisions of the second kind with excited atoms, in which the reaction can be represented by the equation  $A + B' \rightarrow A^{+'} + B$ . The present phenomenon represents then a type of impact in which, clearly, the reverse process is involved.

A full report of the experiments will be published shortly.

K. R. RAO.

Solar Physics Observatory,  
Kodaikanal, S. India, April 8.

<sup>1</sup> NATURE, 128, 585, Oct. 3, 1931.

<sup>2</sup> A. S. Rao, *Proc. Phys. Soc.* (in the course of publication), As II ( $4p \ ^3P_0 - ^3P_2 = 2540$ ;  $4p \ ^1S_0 - ^1D_2 = 12,504$ ;  $4p \ ^1D_2 - ^3P_2 = 7555$ ); (unpublished results) As I  $4p \ ^4S_2 = 85,000$ ).

<sup>3</sup> Beutler and Josephy, *Naturwiss.*, 15, 540; 1927.

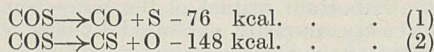
<sup>4</sup> Duffendack and Smith, *Phys. Rev.*, 34, 68; 1929.

## Photochemical Dissociation of Carbonyl Sulphide

WE have recently determined the ultra-violet absorption spectrum of carefully purified carbonyl sulphide, using a quartz spectrograph and a hydrogen discharge tube as a source of light. The spectrum shows a continuous absorption starting from a sharp limit at  $\lambda = 2550 \pm 20$  Å. and extending far towards the ultra-



violet. This spectrum is interpreted as corresponding to the dissociation of the COS molecule, which was also indicated by the deposit of sulphur on the walls of the absorption tube. The products of dissociation may be CO and S, or CS and O. The energies of these processes as calculated from thermochemical data are:



The determined photochemical dissociation energy is  $4.84$  volts or  $111 \pm 1$  kcal. and hence the dissociation must proceed according to (1). The difference between the observed and calculated dissociation energy is  $35$  kcal. and corresponds to the excitation energy of the sulphur atom, since the first excitation potential of the carbon monoxide molecule, as obtained from band spectra analysis, is  $5.9$  volts above the ground-level. The energy of  $1.5$  volts ( $35$  kcal.) corresponds to the difference in energy between the  $3p$  ground-level and the  $1d$  metastable state, as the lowest possible excitation energy of the sulphur atom. The position of the latter term has not yet been established directly. Christy and Naudé<sup>1</sup> have recently suggested  $1.6$  volts from a study of the predissociation spectrum of the sulphur molecule. This is in excellent agreement with the above value.

W. LOCHTE-HOLTGREVEN.  
C. E. H. BAWN.  
E. EASTWOOD.

Physical Laboratories,  
University of Manchester.

<sup>1</sup> Christy and Naudé, *Phys. Rev.*, **37**, 907; 1931.

### Rotation of Molecules in Crystals

AN investigation on the relation between the crystal structure and optical properties of organic crystals has revealed further cases of 'rotating' and 'fixed' molecule forms in aliphatic compounds. A hexagonal rotating form has been observed between  $16^\circ$  and  $24^\circ$  C. in dodecyl alcohol  $\text{C}_{12}\text{H}_{25}\text{OH}$ . The distance between chains is  $4.76$  Å., corresponding to the  $4.85$  Å. found by A. Müller<sup>1</sup> for paraffins. The low temperature form, however, differs by being monoclinic with inclined chains corresponding to the high temperature form of the monobasic acids. The transitions between these forms could be followed for single crystals in the polarising microscope.

A non-rotating form of alkyl-ammoniohalide has been found for  $\text{C}_{16}\text{H}_{37}\text{NH}_3\text{Cl}$ . It is orthorhombic with a base  $5.2$  Å.  $\times$   $5.15$  Å. as against  $5.02$  Å. for the tetragonal 'rotating' lower members studied by S. P. Hendricks and others,<sup>2</sup> but with the hitherto unobserved feature of four layers per cell in alternate pairs inclined approximately  $48^\circ$  to the  $c$  plane. This leads to a negative birefringence unlike that of all other long chain compounds.

J. D. BERNAL.

Dept. of Mineralogy and Petrology,  
Cambridge.

<sup>1</sup> NATURE, **129**, 436, March 19, 1932.

<sup>2</sup> *Ibid.*, **128**, 410; 1931.

### Heat of Dissociation of Nitrogen

THE value of the heat of dissociation of nitrogen has formed a lively subject of controversy in the past few years. All values from  $19$  to  $7$  volts have been given by various workers for the dissociation potential. I have recently determined this value by examining the absorption spectrum of  $\text{N}_2\text{O}$  in a manner which has already been explained in my note on the spectrum

of  $\text{SO}_3$ .<sup>1</sup> The value comes out to be  $8.8$  volts or  $203$  kcal.

The absorption spectrum of  $\text{N}_2\text{O}$  is perfectly continuous, with no trace of bands, as in most saturated compounds. From microphotometrical study of the absorption spectra taken at different pressures, I found that the absorption begins at  $22740$ , corresponding to  $104.4$  kcal. Assuming that this corresponds to a photochemical breaking up of  $\text{N}_2\text{O}$  into NO and N (this assumption is supported by other arguments), and utilising other thermochemical data, the heat of dissociation comes out as  $203$  kcal. This value is in good agreement with the most recent results of Turner and Samson,<sup>2</sup> and Tate and Lozier,<sup>3</sup> obtained by other methods, and is certainly the most accurate value of the heat of dissociation of  $\text{N}_2$  obtained so far.

ARUN K. DATTA.

Department of Physics,  
Allahabad University,  
March 31.

<sup>1</sup> Datta, NATURE, **129**, 317, Feb. 27, 1932.

<sup>2</sup> Turner and Samson, *Phys. Rev.*, **34**, 747; 1929.

<sup>3</sup> Tate and Lozier, *Phys. Rev.*, **39**, 254; 1932.

### Decomposition of Hydrogen Peroxide by Catalase

IN his recent statistical calculations on the decomposition of hydrogen peroxide by catalase, Prof. J. B. S. Haldane estimated<sup>1</sup> that the mean life of an active catalase-hydrogen peroxide molecule is about  $10^{-7}$  second, and the velocity constant for the union of catalase and hydrogen peroxide exceeds  $7 \times 10^9$ .

Work at present in progress, consisting of a comparison of the photochemical decomposition with the enzyme reaction, indicates that the latter may have to be regarded as a *chain reaction*, in which the active centres of the enzyme function only by starting the chains, which then continue in the bulk of the solution, or on other surfaces.

This view becomes more credible in the light of recent work by Allmand and Style, who conclude that even in dilute aqueous solutions of hydrogen peroxide "the photochemical, and hence presumably the thermal reaction, is a chain reaction", and "the reaction chains must be exceedingly long—of the order of  $10^4$  to  $10^7$  links".

According to this view, the inhibition of enzyme reactions may be due in some cases to the breaking of the reaction chains by the inhibitors, as in numerous photochemical reactions.

Zeile and Hellström have shown that iron-porphyrin compounds form the active centres in catalase, and, in 1931, I observed that the action of iron compounds in certain inorganic systems analogous to enzyme systems can best be explained by the chain-reaction hypothesis,<sup>2</sup> a view which was put forward independently by Prof. Haber a few weeks later.<sup>4</sup>

I conclude that in view of these facts a modification may have to be introduced into Prof. Haldane's interesting calculations on catalase.

DEREK RICHTER.

Dyson-Perrins Laboratory,  
Oxford, May 12.

<sup>1</sup> *Proc. Roy. Soc., B*, **108**, 559; 1931.

<sup>2</sup> *J.C.S.*, 621; 1930.

<sup>3</sup> *Ber.*, **64**, 1240; 1931.

<sup>4</sup> *Naturwiss.*, **22**, 450.

### Electrochemical Periodicities

THE interesting observation of periodicity at a platinum anode in a solution of dilute sulphuric acid containing dissolved hydrogen, recently reported by Butler and Armstrong,<sup>1</sup> recalls an unpublished experiment which I made in 1927 during the course of a series of investigations of this subject.



I found that when copper was made the cathode in 10 per cent nitric acid at low current densities (about 5 ma. per sq. cm.), its potential oscillated continuously in periods having a duration of about 1 second and an amplitude of about 0.1 volt. No gas was evolved. This case is complementary to that reported by Butler and Armstrong; for, whilst their observations refer to an anodic process in a reducing solution, mine are concerned with a cathodic process in an oxidising solution. I assumed the periods to be connected with the formation of reduction products of nitric acid—probably ammonia.

Regarding the cause of the periodicity, my experiments on anodic reactions (described fully in "Protective Films on Metals". London: Chapman and Hall) showed that the phenomenon appears when the electrode has almost equal chances of being 'passive' or 'active', or, in general, of being coated or not with a more or less protective film. The phenomenon also appears at the cathode when two reactions are equally probable, and all the evidence points to a critical concentration of ions which must be attained in order to effect the change from one state to the other; a fresh period begins each time the critical concentration is reached by diffusion.

The existence of periods at both anodes and cathodes may be expected by analogy, therefore, when the oxidising or reducing tendency of the electrode is approximately equal to the reducing or oxidising power of the solution. Two years ago I commenced preliminary experiments with the intention of leading to a general study of the cathodic reduction of oxidising solutions and the anodic oxidation of reducing solutions from this point of view, but the work had to be discontinued.

ERNEST S. HEDGES.

Carfax, Urmston,  
Manchester.

<sup>1</sup> NATURE, 129, 613, April 23, 1932.

#### Dependence of Angle of Contact on the Constitution of Adsorbed Organic Compounds

In the course of an investigation conducted on behalf of the Broken Hill South, North Broken Hill, Zinc Corporation, Electrolytic Zinc, Mount Lyell, and Burma Corporation Mining Companies, measurements were made by two of us of the effect of xanthates on the angle of contact at a line of triple contact, mineral-water-air. These have been reported in Technical Publication No. 461 of the American Institute of Mining and Metallurgical Engineers. A trace of potassium ethyl xanthate, dissolved in the water, leads to an angle of contact which is independent both of the concentration of the xanthate and the nature of the mineral. Another compound containing the ethyl group, sodium di-ethyl dithiophosphate, leads to an identical angle of contact. At the time of publication of the above paper it was uncertain whether this was merely a coincidence.

Under an arrangement with the University of Melbourne, the measurements have now been extended by the third author (E. E. W.) to include several other organic types. It has been proved that several ethyl derivatives containing the -SH group lead to this same angle of contact ( $60^\circ \pm 2^\circ$ ). Moreover, each alkyl or aryl group exhibits a characteristic angle of contact, which apparently is independent of the nature of the polar group of the adsorbed molecule.

During the course of this work the contact angles at the surfaces of a large number of minerals and metals have been investigated.

It is inferred that the mineral or metal surface is covered by a unimolecular film of the thio-compound, in which the alkyl group is oriented outwards, and

that the alkyl groups are packed as closely as their size will permit.

Details of the investigation will be published elsewhere.

A. B. COX.

ELSIE E. WARK.

I. W. WARK.

Department of Chemistry,  
University of Melbourne, March 11.

#### Rediscovery of *Caloprymnus campestris* (Marsupialia)

SINCE Sir George Grey sent the three original specimens to the British Museum, in 1843, this interesting marsupial, one of the 'Rat-Kangaroos' of the subfamily Potoroinæ, has been completely lost to science. There is a somewhat doubtful record of it in 1878, but no specimen of the animal exists in any museum in Australia, and there was much to justify the generally accepted view that the animal was extinct.

Following the preliminary announcement by me in September last<sup>1</sup> that *Caloprymnus* was still extant, field work was undertaken in the locality of the first occurrence, with considerable success. The animal has now been shown to have a wide but sporadic distribution in the great area of sandhill and gibber plain country enclosed by the Diamantina and Cooper Rivers between latitudes  $24^\circ$  and  $29^\circ$  south (approximately).

Evidence obtained indicates that *Caloprymnus* has had a long and probably uninterrupted tenure of the area, but that normally its occurrence is very sparse. The passing of drought conditions has apparently provided a stimulus, resulting in a considerable local increase in its numbers.

A series of specimens in several developmental stages was secured, and a restatement of the characters of the animal and of its habits and economy is being prepared. The locality from which Sir George Grey's specimens come is uncertain. Any information on this and allied points, by students in England who have had access to Grey's papers, especially his correspondence with Gould, would be welcomed by me.

H. H. FINLAYSON.

The University, Adelaide,  
April 12.

<sup>1</sup> *Trans. Roy. Soc. S. Aust.*, 55, p. 162.

#### Heterospory and the Angiosperms

PROF. RUGGLES GATES in his interesting letter on this subject<sup>1</sup> compares the size of the microspore and megaspore *mother-cells* in Angiosperms, and finds that the former are in some cases larger than the latter. But is the size of the *mother-cells* material to the question? Surely it is the relative volume of the mature and functional microspores and megaspores which determines heterospory. In the heterosporous Pteridophytes there may be little or no difference in the size of the respective *mother-cells* up to the time of their division.

As a palæobotanist, I have no prejudice in favour of the origin of the flowering plants from heterosporous Cryptogams. The fossil evidence so far lends no support to this classical hypothesis. But it does seem to me that the existing Angiosperms (and Gymnosperms also) do, as a matter of fact, show in general a marked heterosporous differentiation, if one compares their pollen grains and embryo sacs when functionally mature.

D. H. SCOTT.

East Oakley House,  
Basingstoke, May 31.

<sup>1</sup> NATURE, 129, 793, May 28, 1932.



### Research Items

**Bride Wealth among the Hehe, Tanganyika Territory.**—In *Africa* (vol. 5, No. 2) for April, Mr. G. Gordon Brown analyses the custom of the bride-price, or bride wealth as he prefers to call it, with reference to its several functions in relation to the observances connected with marriage. The primary function of *mafungu* is to stabilise marriage. Its amount is one of the essential matters settled at the betrothal ceremony, when relatives of both families are present. The last word lies with the father of the bride, who first names the amount and may or may not agree to any change afterwards suggested by the relatives on his side. The groom does not pay the amount out of his own wealth, but is assisted by his kinsmen, the father or father's family usually supplying two-thirds of the amount, and his mother or mother's family one-third. It is supposed to be paid to the bride's father on the day of the wedding. He keeps two-thirds and gives one-third to the bride's mother. Until the *mafungu* is paid, the marriage is not considered to be binding. Its payment is, in fact, necessary to legalise the marriage. Unless it has been paid, a husband cannot sue for adultery compensation. In case of divorce, the *mafungu* must be returned. The interest of the family in the *mafungu*, their co-operation in raising it, and the difficulties of collecting it when returnable on dissolution of the marriage, give the families an interest in maintaining the marriage and endeavouring to avert a possible divorce. In certain cases, such as cross-cousin marriage, the *mafungu* is less, as the bond of kinship makes it unnecessary to require so large an amount to secure the desired stability.

**Warfare in Eddystone Island.**—Mr. A. M. Hocart has described (*J. Roy. Anthropol. Inst.*, 61, pt. 2) the methods of warfare of the inhabitants of Eddystone of the Solomons. The natives still go armed, although the spear and shield are not now carried; but a man will scarcely abandon his tomahawk, which is, besides, a handy tool for husking coco-nuts and cutting branches. It has displaced the original weapon, a paddle-shaped club. Warfare may be divided into wars of revenge and head hunts. The two chief causes of internal strife are murder and adultery. Heads are not caught at random, but for the definite purpose of inauguration, the term used in the vernacular meaning 'to moisten' or 'to wet', presumably with blood, the occasion being the inauguration of new canoes, new communal houses, new skull houses, the death of a chief, and the release from confinement of a widow. Ysabel became the favourite hunting ground for the people of Eddystone. Turtle expeditions were often pretexts for head hunts. Slaves were also captured; but when captured a slave is really supposed to be dead. Cannibalism appears to have been little practised. War canoes are no longer in existence, but formerly there were several in each district. Ceremonies were carried out before departure. If an enemy made a raid on the island, revenge was taken by attacking the aggressors and carrying off a captive, who was sacrificed. A festival was held in honour of a manslayer after the return of an expedition, for which the giver of the feast had to collect food, mainly pigs and taro. A feast was also held after the first successful raid of a new canoe.

**Duckbilled Platypus.**—In *Blackwood's Magazine* for May (p. 717), H. A. Roome gives some interesting notes on his attempts to keep the duckbilled platypus in captivity during a stay in Tasmania in 1888. The

animals' behaviour as described does not give the impression of low mentality at all; they displayed a disconcerting activity in climbing wire-netting as soon as confronted with it, and a pair which were kept for about a week exhibited playfulness which would have been noteworthy in any mammal, gambolling together not only in the water of their tank, but also among the weeds of their enclosure. It is unfortunate that the duckbill, unlike its fellow-monotreme the echidna, is so delicate in captivity, the pair above mentioned having so soon succumbed although supplied with natural food from a pond. Bennett did better with a pair of young ones in 1860, allowing them the run of a room and feeding them on artificial food; yet they lived little more than a month. A few years ago, however, a platypus was successfully taken to America and exhibited, being fed on shrimps and earthworms. Probably an experienced conveyer of the more delicate insectivorous birds would succeed with this most interesting mammal.

**Development of the Vertebral Column.**—What may perhaps be called the standard account of the development of the vertebral column in the Gnathostomata, since it occurs in many textbooks, is based upon the investigations of Gadow and Abbott. Subsequent work has shown that this account is in need of revision in various important points. Prof. E. W. MacBride has performed a useful service in surveying the researches into this problem in Elasmobranchs (Ride-wood), Teleostei (Ramanujam), Amphibia (Mookerjee), Aves (Püper), and Mammalia (Dawes) which were carried out in the Department of Zoology at the Imperial College of Science (*Biological Reviews*, April 1932). In a brief notice it is not possible to refer to all the details dealt with in what is itself a condensed review. The vertebrae in most Elasmobranchs, save a few primitive forms, are not chordacentrous but their centra are perichordal. They are also perichordal in all the higher groups, and the arcualia—basidorsals, basiventrals, and ribs—are developed in the myocommata. There is a much closer fundamental agreement between the various groups than was generally supposed, and not the great break between Amphibia and Amniota. The important difference between these groups is not in the method of formation of the vertebrae, but in the fact that in the latter alone (or at any rate in the Mammalia) five anterior segments of the vertebral column fuse with the skull. The paper is illustrated by forty-eight text-figures, but it is a pity in so useful a work that some of them are badly drawn, and the reader is not aided in tracing the originals, as there is no direct acknowledgment of their origin.

**Size and Shape Factors in Fruits.**—Plant varieties are often distinguished by the size or shape of their fruits, but relatively little is known regarding the genetics of these differences. An interesting contribution to the subject has been made by Dr. E. W. Sinnott (*J. Heredity*, vol. 22, No. 12), who crossed varieties of *Cucurbita pepo*. In some races the fruits may be five times as long as their diameter, while in those with flat fruits the width may be three times the length. Some of the types isolated also differed greatly in size of fruit. In crosses, certain shape differences showed sharp monohybrid segregation in  $F_2$ . A study was made of the relation between size and shape in certain crosses. Two pure lines which differed markedly in fruit size and shape were crossed. One had a small spherical or pear-shaped fruit



(average diameter, 11 cm., average weight, 700 gm.). The other had a large disc-shaped fruit (7 cm.  $\times$  18 cm., 1300 gm. weight). The disc shape is completely dominant, with a 3 : 1 ratio in  $F_2$ . But the  $F_2$  discs and spheres were of the same average weight (about 1030 gm.). The  $F_2$  fruits showed greater variability in weight than the  $F_1$ , suggesting multiple factors for size. Thus there was present a single pair of factors governing fruit shape, presumably acting through control of growth correlation; and a series of factors governing volume or weight, and probably effective through control of the amount of material at the command of the growing fruit. The size factors appear, moreover, to be independent of the shape factors, and there is no evidence for the existence of genetic factors directly controlling single dimensions.

**The Magma of Vesuvius.**—In *Die Naturwissenschaften* for April 29, Dr. A. Rittmann discusses the origin of the magma represented by the lavas of Vesuvius. The prehistoric lavas of Monte Somma can be satisfactorily regarded as vicoite (sanidine bearing leucite-tephrite) and its leucocratic and melanocratic differentiation products, leucite-phonolite and ottajanite respectively. Leucite-phonolite was last erupted in A.D. 79, when Pompeii was overwhelmed. Since then, Vesuvius has developed from a magma having the composition of leucite-tephrite. No significant variation has been observed in the lavas from 1631 to the present day. Variation diagrams show that the Vesuvius magma lies within the range covered by the earlier Somma magmas. It is clear, however, from the chemical and mineral characters, that the Vesuvius magma cannot be a residual magma produced by the separation of early formed crystals from the vicoite magma of Somma. Dr. Rittmann suggests that the difference can be ascribed to assimilation of the Triassic dolomitic limestone that underlies the volcanic pile, accompanied by crystallisation differentiation. The separation and sinking of aggregates of augite, biotite, olivine, and anorthite, represented by ejected blocks of missourite, puglianite, sebastianite, biotite-pyroxenite, and olivine-pyroxenite, would remove from the system vicoite plus dolomitic limestone just those constituents required to leave a magma relatively impoverished in magnesia and silica and enriched in alkalis and gases. The hypothesis is one which will readily commend itself to most petrologists. It should, however, be noticed that assimilation of carbonates does not here provide an origin for the alkali-rich character of the original magma of Somma, but only for the change in composition from vicoite to leucite-tephrite.

**The Shyok Ice Barrier.**—In view of the disastrous flooding from the Shyok lake in the Karakoram in 1929, a note on the present state of the ice dam is of interest. It was visited in 1931 by Capt. C. E. C. Gregory, who records his observations in the *Himalayan Journal* for April 1932. The snout of the Chong Kumdan glacier which dams the valley was then about 1500 yards wide and about 200 feet high, and the lake behind it had a surface area of over thirty miles, and was standing 30-40 feet below its highest level. The ice is apparently in a state of retreat, but there is little loss of water from the lake by percolation through the dam. The deep channel cut in the ice by the burst of 1929 had completely healed in a year. Estimating from the steady rise in the waters of the lake, Capt. Gregory believes that it will overflow or burst the barrier again in 1932. Major K. Mason, discussing the problem from the data available, thinks that degeneration of the glacier snout

will allow heavy percolation of water and so relief of pressure, and provided the normal high level of water in the summer of this year is safely passed, there will be no further danger of a burst for many years. He is not, however, so sure as Capt. Gregory of the probability of a serious burst during this summer.

**Hair Hygrometer.**—The hair hygrometer is the simplest type of instrument for indicating the relative humidity of the air without the necessity either for calculations or the use of charts. Being dependent for its functioning on the reproducibility of the hygroscopic properties of hair, this form of hygrometer needs checking from time to time by reference to a ventilated wet and dry bulb hygrometer or a dew point apparatus. Messrs. Negretti and Zambra have recently placed on the market a compact form of hair hygrometer. The instrument is of circular pattern, measuring 4 inches in diameter by 1½ inches in depth, and is described by the makers as being a wall or pocket type. The scale is enamelled on metal, and therefore not liable to distort with humidity changes as sometimes happens with paper scales. The operating mechanism is simple, consisting of a bundle of hairs anchored at one end, passing over a pulley, and coupled at the other end to a variable throw crank. Tension is maintained by a spring. The variable throw crank permits of control on the magnification of the movement, so that the scale can be adapted to a particular bunch of hair. The usual form of zero adjustment is provided. A few precautions are necessary in the use of an instrument of this type: (1) it should not be exposed to direct sunshine, otherwise errors will be introduced, due to the warming up of the blackened case of the instrument and the lowering of the relative humidity of the air inside; (2) time must be allowed for equilibrium to be reached if the instrument is taken from an atmosphere of one humidity into another of a different humidity, since the air has to diffuse into the instrument through slits in the case.

**Origin of the  $\gamma$ -Rays from Actinium Emanation.**—Two observations have been made recently on the properties of the radioactive gas actinon which afford evidence for the hypothesis that  $\gamma$ -rays have their origin in transitions of  $\alpha$ -particles inside an excited nucleus, and not in the movement of electrons (*Roy. Soc. Proc.*, May). The first consists in an observation by W. B. Lewis and C. B. Wynn-Williams with an electrical counter on the  $\alpha$ -particles from actinon, which has shown that these are heterogeneous; one of the two groups emitted has a range in air of 5.6 cm., and the other a range of 5.2 cm. On the above theory of the  $\gamma$ -rays, the difference in energy,  $3.6 \times 10^5$  electron-volts, should also appear as a  $\gamma$ -ray quantum in the actinon-actinium *A* disintegration. That this probably occurs has been shown by Lord Rutherford and B. V. Bowden by a second set of experiments, in which the radiation from a current of air containing actinon was examined with a Geiger-Müller tube counter, and  $\gamma$ -rays of about the expected penetrating power found. Before these observations it had been supposed that the emanation emitted only  $\alpha$ -rays, but in addition to the  $\gamma$ -radiation, a weak  $\beta$ -radiation, probably due to internal conversion of the  $\gamma$ -rays in their escape from the nucleus, has also been detected with an electroscope.

**The Theory of Radiation.**—This problem, an outstanding example of the incomplete success of modern quantum theory, is discussed at some length by Prof. C. G. Darwin in the May number of the *Proceedings of the Royal Society*. An essential point in the modified theory which he outlines is that the general similarity



of electrons and photons in behaving both as particles and waves should be recognised. The difficulties which arise from the apparent annihilation of a photon when it is absorbed can be neglected, at least in the first instance, but it is necessary to make an abrupt departure from earlier work by treating the electric force in an electromagnetic wave as an unobservable quantity; it is not considered identical with a static electric force, or even with the force in wireless waves when they involve a large number of photons, but is taken to be a quantity like the  $\psi$  of wave-mechanics, and a set of six components of the electric and magnetic vectors adopted as wave-functions. Development of this idea then leads, as for the electron, to the difficulty that states of negative energy should arise, and, as appears also to be done now for the electron, this is deliberately ignored. Prof. Darwin remarks that the troubles of the quantum theory are apparently increased by this, but that it is usually found that the best hope of resolving a deep difficulty is to extend its application as far as possible. Further elaboration furnishes the angular momentum of the quantum, analogous to the spin of the electron, and with it an example of the duality of the quantum theory, in insisting both

that the angular momentum of a system must be an exact multiple of the quantum and that it is impossible to measure it to the nearest quantum. The remainder of the paper deals in a preliminary way with the perturbation of a photon by an electron. In the same number of the *Proceedings*, Dr. P. A. M. Dirac gives an account of a quantum theory in which the interactions between particles take place by means of vibrations of an intervening medium transmitted with a finite velocity, and Prof. Wasastjerna discusses the quantum statistics of X-rays.

**Natural Regulators of Protein Metabolism in Plants.**—Mothes has published a highly interesting note on this subject (*Naturwiss.*, 6, 102; 1932) in which he claims that a regulator can be extracted from plants, which largely determines whether proteins are built up or broken down. The substance is acetone soluble, and it activates protein hydrolysis when in a reduced form but not when in its oxidised form. In the former case, it reacts with sodium nitroprusside to indicate a sulphhydryl grouping. Its further investigation obviously promises a considerable addition to our knowledge of the vexed questions surrounding protein synthesis in plants.

### Astronomical Topics

**Magnetic Disturbance of May 29–30.**—A considerable magnetic disturbance was registered at the Greenwich magnetic station of Abinger on May 29–30 last. The ranges of the three elements during the disturbance, which began rather indefinitely at about 11<sup>h</sup> on May 29, were as follows: declination 35', horizontal force 340  $\gamma$ , and vertical force 265  $\gamma$ . This disturbance of 'storm' range is the largest recorded at Abinger since March 1929. The sun's activity is now definitely declining towards the minimum phase of the eleven-year cycle, when magnetic disturbances of this magnitude are usually very infrequent.

At the time of the commencement of the 'storm', a fairly conspicuous spot was about 3 days past transit of the sun's central meridian. This suggests a connexion with the storm, though in appearance and size the sunspot was not unusual. On the few occasions at Greenwich when breaks in cloudy skies permitted the spot to be observed spectroscopically (when it was near the centre of the sun's disc) the hydrogen atmosphere in the region of the spot was distinctly active but not to an abnormal degree.

**The Arizona Expedition for the Study of Meteors.**—For many years observations of meteors have been actively carried on in the United States. As the results seemed to indicate that many meteors were moving with hyperbolic velocities, and were therefore visitors to the solar system from the stellar regions, it was seen that statistical study would increase our knowledge of the character and amount of the matter that exists in interstellar space, which is of importance in many problems relating to the star system. Accordingly, Prof. H. Shapley, with the co-operation of Dr. Opik and Prof. Boothroyd, has organised an expedition to the clear air of Arizona, for the statistical study of meteors (*Proc. Nat. Acad. Sci.*, Jan. 15, 1932). The Lowell Observatory is accommodating one of the parties, while others are placed at distances of 2 miles and 23 miles from it; there is thus material for obtaining the real paths of doubly observed meteors. Each observer has the position of his eye fixed by looking through a tube, and the area of sky visible is limited by a square opening, through which a region

80° by 80° is visible. The opening is crossed by bars, which are used to fix the tracks more exactly. There is a rocking mirror that is used for part of the time to determine the speeds of meteors. A star appears as an ellipse in the mirror, but a meteor appears as a wavy curve; the distance between the crests of the waves gives the speed. There is good reason to hope that the results will lead to a great increase of our knowledge of meteors.

Mr. J. P. M. Prentice, director of the Meteor Section of the B.A.A., notes that there is still plenty of scope for amateur work on meteors; the Arizona expedition is mainly to secure general statistics, whereas his section keeps watch on special showers, such as the Perseids, Leonids, etc. These showers are known to belong to the solar system, whereas the special concern of the American expedition is to investigate the cosmical meteors, which come from outside. Of course, the observations must include all the meteors seen, since their relation to the solar system can be inferred only after subsequent discussion.

**The Star 70 Ophiuchi.**—This is an interesting double star which has for a long time perplexed computers owing to apparent irregularities in the motion; this caused suspicion that there might be a third unseen companion, but no satisfactory verification of this supposition has hitherto been obtained. *Lick Bulletin* No. 443 contains a study of this star by Mr. L. Berman. He has examined the radial velocity of the brighter component, and finds that, in addition to the large wave with a period of 88 years due to the known component, there are decided indications of a smaller wave with a period of 18 years, which he ascribes to a small companion (the mass of which is estimated to lie between one-tenth and one-fifth of the sun's) revolving round it. The inclination of this orbit is concluded to be nearly 90°. He notes that the dynamics of this system, if it contains three stars of comparable mass and comparable size of orbits, would be extremely complex, and much work would be required before the exact effect on the motion of the visible pair could be estimated. The parallax is found to be 0.179".



## Congress of the South-Eastern Union of Scientific Societies

THE annual congress of the South-Eastern Union of Scientific Societies was held at the Civil Service Commission, Burlington Gardens, W.1, on June 1-4, the presidential chair being occupied by Dr. R. E. Mortimer Wheeler, keeper of the London Museum. Recalling to mind that the Emperor Augustus was probably the first museum-curator of a kind, as recorded by Suetonius, Dr. Wheeler said that the goal of archæological research is not only the collection of potsherds and the like, but also the reconstruction therefrom of all that has in the past been most vital in human thought and action. The story of Grettir the Strong is that of one of the earliest excavators known to history. Determined to defy the ghost of Kar the Old, he ordered that tools should be made ready for digging up the mound of Kar, and his companion having been scared away by the ghost, Grettir worked alone and brought out much treasure of gold and silver. He also kept silence about it, his enthusiasm not being entirely of an unselfish character. Treasure-hunting remained the main objective until well into the nineteenth century. The despoiling of barrows died hard. In 1844 the *Archæological Journal* recorded the opening of eight barrows in two hours on Breach Downs in the presence of a company assembled for the purpose. It was for them a holiday diversion to see weapons, urns, beads, bones, or glass vessels brought to light and scattered around. No wonder that archæology in its early days had to fight for recognition as a scientific pursuit worthy of intelligent minds.

The amateurishness of the excavations of early Victorian times was no doubt responsible for the low estimation in which archæology was held, but the situation was completely altered with the arrival on the scene of General Pitt-Rivers, who late in life came into possession of a fortune and a large estate in a district of unsurpassed antiquarian interest. It was in Cranborne Chase that the science of archæology was really discovered. British enterprise in the science is now at the full-tide. Not only in our own country but also all over the world, the spade and fork are in capable and energetic hands. But more trained observers and workers are needed. There is lack of the means by which such training can be arrived at. There is now an opportunity such as can never again be seized. An Institute of Archæology is needed, and with the building of a new University of London it is imperative that provision be made for such an Institute. Dr. Wheeler appealed for support of the scheme which has been promulgated by Sir Charles Peers and others.

In the absence of Sir J. Arthur Thomson, a lecture was delivered by Dr. Landsborough Thomson on bird migration, a subject which gives rise to many surmises but about which very little is really understood. The ringing of migrant birds has yielded a good many facts, but at present the return of only some 3 or 4 per cent of marked birds has been noted. Migration cannot be regarded as the result of reasoning. There is no compulsion which makes swallows, for example, breed in England in preference to South Africa, where they find a summer in our winter time. They can have no actual knowledge of our winter climate. We call the conduct of migrant birds instinctive and inherited, but this explains nothing. The true homing instinct is shown in the return of some to their old breeding-places year after year. In this they are aided by their powers of sight, but the actual reasons of their return are unknown. It is one of the great problems yet to be unravelled.

In the Geological Section, Prof. H. L. Hawkins dealt with "Some Episodes in the Growth of South-Eastern England". East of a line joining the Wash with the head of Lyme Bay, the area is almost entirely covered by Cretaceous or later deposits, but just outside it palæozoic rocks, the pre-Cambrian and Carboniferous, reach the surface in South Leicestershire and the Mendips, and they extend into the area under the newer cover of rocks. These two ancient series of rocks give a clue to the foundations of the area. The Charnian line passes from Leicestershire in a south-easterly direction under east London, and the Mendip line takes a mainly easterly course linking Frome with Dover. The influence of the latter is seen in the east and west trends of the later rocks. The southern edge of the palæozoic massif under the North Downs is as clearly defined as is its western edge by the Mendips and their extension through Pembrokeshire. Assuming a northern edge determined by the Midland ridge and an eastern margin of similar rocks under the North Sea, we find postulated a nearly square basin, bounded by palæozoic ridges, with its corners at London, Bristol, the Wash, and near Ironbridge, and at each corner where the intersecting ridges cancel out are the exits of the chief rivers of the basin. In this basin Triassic and Jurassic rocks were developed on a grand scale. Prof. Hawkins then gave his conception of the landscape of the area in Triassic times, the middle floor of the area, and passed on to the upper floor of Cretaceous time, when the uplift excluded the chalk sea. The south-easterly dip of the older systems then caused the elevation of the western parts before the eastern had emerged, thus resulting in a shoreline running north-east by south-west, which crept towards Dover as the uplift progressed.

In the Botanical Section, Mr. J. Ramsbottom, of the Natural History Museum, gave a paper on "Fungi as Scavengers", showing how humanity is indebted to these lowly organisms for many of the comforts of civilisation; and Mr. A. J. Willmot followed with a paper on "The London Flora", as it was and as it now is.

Old-world enjoyment of life in the Middle Ages was the subject of "Medieval Games and Gaderings", by Dr. W. E. St. L. Finny; and in the Zoological Section, Mr. Hugh Main showed much of his excellent photographic work in "The Camera as a Naturalist's Recorder". Original slides from his own photographs illustrated Mr. E. J. Bedford's "Some Ground-nesting Birds".

"Town and Country Planning" was dealt with by Mr. G. L. Pepler in the Regional Survey Section, and it was pointed out that town-planning really includes that of rural districts, for the planning of one of the latter is in order to provide against irregular and bad planning when such parts come to be built over.

Some remarkable slide-pictures by Mr. M. Maxwell were shown by Capt. Guy Dollman in his lecture on "Great Game Animals of Africa", and his lecture was a model of what a carefully prepared and well-delivered lecture should be.

Excursions to suit all scientific tastes occupied each afternoon, visits to the London Museum, the Natural History Museum, Zoological Gardens, Swanscombe, Abbey Wood, Hampton Court, Burnham Beeches, and other places being made. A four-hour cruise in the Port of London was a popular feature. Under the leadership of Mr. A. Farquharson, a survey walk was made in Westminster and Pimlico.

Prof. E. J. Salisbury was elected president of the Congress for 1933, which will be held at Norwich.



## The Royal Observatory, Greenwich

### ANNUAL VISITATION

THE annual visitation of the Royal Observatory, Greenwich, took place on Saturday last, June 4, when the Astronomer Royal presented his Report to the Board of Visitors on the work of the Observatory during the past year. The Report begins with a statement of the progress that has been made in the construction of the two new instruments and the buildings for them, which are situated in the magnetic enclosure, at some distance from the present buildings. The large concrete block, 15 ft. square and 9 ft. thick, on which the transit circle will rest, is in position, and the piers for the collimators, each distant fifty feet from the instrument, are in position. Messrs. Cooke, Troughton and Simms have already completed the three objectives, each of 7 in. aperture. The transit micrometer is to be motor-driven. The circles will be 24 in. in diameter. It is proposed to construct one circle of glass; the divisions will be read through the glass, and will be protected at the back by a metal plate, to obviate the need for cleaning; it is found that this is apt to cause slight changes in the divisions in the course of time. The Johnstone Yapp 36-in. reflecting telescope is being constructed by the firm of Sir Howard Grubb, Parsons and Co. A large part of the mechanical work is completed, also the smaller mirrors. The mounting will be of the modified English type. The building of the dome is far advanced.

The usual observations have been carried on with the Transit Circle. The moon was observed on 74 days; the correction indicated to Brown's longitude of the moon in 1931 is  $+4.8''$ ; it has been steadily diminishing since 1924, when it was  $+7.2''$ ; the correction to the latitude has remained nearly constant at about  $-0.8''$ . The proper motions of stars in Boss's General Catalogue have been revised—those of the remaining stars brighter than mag. 8.0 in the zone N. Decl.  $32^\circ$  to  $40^\circ$ . 311 double stars were measured with the 28-in. equatorial; 55 of them were closer than  $0.5''$ . 1223 plates were taken for stellar parallax with the 26-in. equatorial; 1128 plates were measured, and parallaxes of 37 stars deduced; results were given in *Monthly Notices* of the Royal Astronomical Society for November last.

The programme of work on star temperatures has been carried on with the 30-in. reflector; a volume is in press containing the absolute colour temperatures of 25 standard stars and 38 other stars. 106 plates were taken with the astrographic equatorial for the determination of proper motions in the Greenwich zone, which extends from Decl.  $64^\circ$  to the pole. This work has now been completed and is nearly ready for press.

Photographs of the sun were obtained on 261 days; the missing days are filled in with plates from the Cape and Kodaikanal. Sunspot activity has continued to diminish, and the minimum is expected in a year or two. Observations were made with the spectrohelioscope on 154 days; measures of radial velocities of flocculi have been published in *Monthly Notices* of the Royal Astronomical Society.

The Report describes the preparations for the solar eclipse of Aug. 31 next; Dr. J. Jackson and Mr. C. R. Davidson are going to Parent, on the Canadian National Railway, which will also be occupied by a party from Ottawa Observatory. Mr. Worthington has lent a 6-in. lens of 45 ft. focus for photographs of the corona; various spectroscopic researches will be carried on.

A determination has been made of the longitude and latitude of the Abinger magnetic observatory; they are  $0^\circ 23' 12.06''$  W.,  $51^\circ 11' 5.17''$  N. The

magnetic elements for 1931 are: Decl.  $12^\circ 13.7'$  W.; Hor. Force 0.18544; Vert. Force 0.42923; Dip  $66^\circ 38.1'$ .

The following weather statistics refer to the year ended April 30, 1932, the averages with which they are compared being those of the 75 years 1841–1915. The mean temperature had the exact average value  $49.5^\circ$ . The maximum was  $81.2^\circ$  on July 12, the minimum  $20.6^\circ$  on Dec. 31. There were 49 days of temperature  $32^\circ$  or lower. The mean daily movement of the air was 281 miles, which is 4 below the average. The maximum was 691 miles on Dec. 4. The duration of bright sunshine was 1180 hours; there were 87 entirely sunless days. The rainfall was 23.89 inches, which is 0.35 below the average; the wettest and driest months were August and February, with 6.27 and 0.29 inches respectively.

Observations for time were made with the small reversible transit instrument on 63 nights. On Feb. 18 last, Shortt No. 11 was adopted as the standard sidereal clock instead of Shortt No. 3; the latter has been fitted with a new invar pendulum and bob.

The rhythmic time-signals have been sent to Rugby at  $10^h$  and  $18^h$ ; they are now preceded by warning signals. The usual comparison of time-signals with those of Paris, Nauen, Annapolis, and Bordeaux is given in the report; they are, in the mean, later than Greenwich by  $0.007^s$ ,  $0.031^s$ ,  $0.026^s$ , and  $0.015^s$  respectively.

The Astronomer Royal observes that this is his last annual Report to the Board, and gives a summary of the work carried on at the Observatory since his appointment in 1910.

## University and Educational Intelligence

**BIRMINGHAM.**—Dr. L. J. Wills has been appointed to the chair of geology, to succeed Prof. W. S. Boulton, who retires at the end of the current session.

Mr. William Gemmill, honorary surgeon to the Queen's Hospital, has been appointed joint professor of surgery, to succeed the late Prof. William Billington.

**CAMBRIDGE.**—It is proposed to appoint a Syndicate consisting of the Vice-Chancellor, Dr. E. D. Adrian, the University Treasurer, Prof. R. H. Fowler, Mr. F. T. Brooks, and Mr. R. E. Priestley to consider the organisation of the research institutes in the University and their relations to the University and its departments, and to report to the University by the end of the Lent Term, 1933.

**LONDON.**—Prof. H. V. A. Briscoe, since 1921 professor of inorganic and physical chemistry at Armstrong College, Newcastle-on-Tyne, has been appointed to the chair of inorganic chemistry at Imperial College (Royal College of Science) as from Oct. 1, 1932.

Mr. S. G. M. Ure, since 1921 lecturer in chemical engineering at the Imperial College, has been appointed reader.

The title of professor of physical chemistry in the University has been conferred on Dr. Samuel Sugden, in respect of the post held by him at Birkbeck College.

Prof. F. A. von Hayek has been reappointed to the Tooke chair of economic science and statistics tenable at the London School of Economics.

The Dunn Exhibitions in Anatomy and Physiology for 1932 have been awarded respectively to Mr. J. E. Spalding and Mr. W. N. Mann, both of Guy's Hospital Medical School.

**WALES.**—Applications are invited for the following scholarships: The Mrs. John Nixon Research Scholarship in the Department of Medicine and



Medical Pathology, value £150; the Lord Merthyr Research Scholarship in the Department of Surgery, value £200, and the Ewen Maclean Research Scholarship in the Department of Obstetrics and Gynaecology, value £150. Applications must reach the Registrar, University Registry, Cathays Park, Cardiff, not later than Sept. 1.

A FELLOWSHIP for research in aeronautics is being offered by the Armourers and Brasiers' Company, the tenure of which will be two years and the annual value £300. Applications must reach the Clerk to the Company, Armourers' Hall, 81 Coleman Street, E.C.2, by, at latest, June 30.

APPLICATIONS are invited by the Agricultural Research Council for three agricultural research scholarships, each of the yearly value of £200 and tenable for not more than three years, and for two veterinary research fellowships, value £300 a year and tenable for not more than three years. All candidates must be nominated by a professor or lecturer of a university, college, or medical school, or by the director of a research institute. Forms and full particulars can be obtained from the Secretary, Agricultural Research Council, 6A Dean's Yard, S.W.1.

THE education of American Indians and Negroes and natives of the principal outlying possessions of the United States—Hawaii, Porto Rico, the Philippines, and Alaska—is dealt with in *Bulletin*, 1931, No. 20, of the Office of Education, Washington. This survey of American experience during the past ten years of educational problems arising from the necessity of integrating people of widely different racial origin, traditions, and beliefs in a new social and economic order will be read with interest by educational administrators in other parts of the world, notably in the African dependencies of Great Britain. Educational policies have aimed at preserving the best in native cultures, as well as the special gifts and talents with which, as individuals and groups, the native and minority peoples are endowed, and at transferring responsibility for administration, supervision, and instruction, as rapidly as possible, to the groups themselves. In Porto Rico and in the Philippines, such a transfer has practically been achieved. In Alaska, the Eskimos and Indians are still to a considerable extent dependent on the guidance of the missionary-teachers sent out by the authorities at Washington. Also in Hawaii, Porto Rico, and the Philippines, increasing attention is devoted to the 'practical' as distinguished from the academic side of secondary school objectives. In Porto Rico, under the pressure of the havoc wrought by a tornado, a new type of rural secondary school has been successfully introduced, in which the courses are based wholly on a vocational programme, with emphasis on those trades which are economically productive in the island.

### Calendar of Geographical Exploration

June 12, 1789.—The Mutiny on the *Bounty*

Capt. William Bligh and a few companions who had been cast adrift in a small boat by mutineers reached Timor safely after having covered 3600 miles. Bligh had been sent out in 1787 in the *Bounty* to transport bread-fruit trees to the West Indies in the hope of introducing their production in those islands. Bligh rounded the Cape of Good Hope and discovered the *Bounty* group of islets south-east of New Zealand. A long stay was made at Tahiti and numbers of bread-fruit trees obtained, the *Bounty* then sailing for Java.

To the north of the Cook or Hervey group, Aitutaki island was discovered, and the ship put in for refreshments at the Friendly Islands. The crew considered these South Sea islands to be ideal and mutinied, hoping to enjoy a life of ease in one of them: some of them became the ancestors of the Pitcairn Islanders. Bligh in the overladen boat, without a chart and with insufficient provisions, had to make his way from the Friendly Islands to Timor. He found a passage through the Great Barrier Reef in about 13° S. and discovered Restoration Island.

June 15, 1869.—East Coast of Greenland

Koldewey's expedition sailed from Bremen, and with him was Payer, the future discoverer of Franz Josef Land. One vessel, the *Hansa*, got separated and crushed in the ice. Her crew built a house on an ice-floe, but this was broken by the splitting of the floe. They drifted, sometimes on their melting island and sometimes in boats, for more than 1100 miles, but finally reached the coast of Greenland in lat. 60° N. The other ship, the *Germania*, had better fortune and Koldewey and Payer reached Sabine Island off the east coast of Greenland, named Kaiser Wilhelm Land, and partly explored Franz Josef Fiord.

June 17, 1853.—The North-west Passage

Capt. R. M'Clure and his officers and crew arrived safely on board the *Resolute*, having been rescued by Lieut. Pim from Banks Island, at a point where M'Clure was, in desperation, about to attempt the same southward journey to the Canadian coast which had proved fatal to Franklin's party. M'Clure had not only discovered but also traversed a north-west passage, partly by a land journey over ice. For this solution of a long-standing Arctic problem M'Clure was knighted and a sum of £10,000 was voted to himself, the other officers, and the crew. M'Clure in the *Investigator* left England in January 1850, with Collinson in the *Enterprise*, but they were accidentally separated before reaching Bering Strait. M'Clure penetrated the arctic from the west and passed the winter of 1850–51 at the Princess Royal Islands, only 30 miles from Barrow Strait. He found it impossible to reach Barrow Strait, though he could see it, because of heavy ice. He wintered on the north coast of Banks Island in 1851–52, and was preparing to abandon the ship in the spring of 1853, when help fortunately arrived. Collinson also succeeded in finding a north-west passage, and after three winters in the arctic returned home in 1854.

June 18, 1851.—The Niger and its Tributaries

Dr. Barth reached the junction of the Faro River with the Benué, here half a mile wide, yet 415 miles distant in a direct line from its confluence with the Niger. He had set out with Richardson and Overweg, under government auspices, to explore the Niger region, starting from Tripoli. At the frontiers of Bornu the party separated, and Richardson and Overweg shortly afterwards died. Barth's extensive travels yielded a rich harvest of geographical, ethnographical, historical, and philological data. He explored the great bend of the Niger, visited the Tuareg tribes and the Hombori mountains, and reached Timbuktu. Thence he explored the Hausa States and saw the miserable villages which were all that remained of the once powerful Songhay Empire, ruined by the attacks of Moors, Tuareg, and Fulah. The interest aroused by Barth's discovery that the Benué so closely approached Lake Chad resulted in a government survey of the possibilities of navigation of the river. Major Laird was in charge, and 340 miles were accurately charted.



## Societies and Academies

## LONDON

Royal Society, June 2.—C. U. Ariëns Kappers: Some correlations between the brain and the skull (David Ferrier lecture). While the brain-case generally adapts itself to the form and growth of the brain, the author begins by giving some examples in which a one-sided external compression (Teleostomes) or a more general space economy in the neurocranium (birds) seems to be the primary factor in determining some external (and internal) morphological features of the brain. He then discusses the brain and skull shape in mammals in relation to bodily characteristics and intrinsic changes in the brain itself, and their influence on the general and fissural aspect of the pallium. Proceeding to the possibility of establishing anthropological differences in the brain, the author discusses the use of certain standard lines, angles, and indices for expressing such differences in figures. He then proceeds to the general and fissural brain morphology of races in which, in addition to other features, the height index of the skull differs a good deal, and he compares the brachy-hypsicephalic Armenian with platy-brachycephalic Northern Mongol and the latter with meso- or subbrachy-hypsicephalic Chinese brain. Further, the Chinese brain is compared with the Japanese brain. The very limited possibility of using the same standard lines for endocranial casts of extinct races is discussed. The brain (endocranial cast) of Dubois' *Pithecanthropus erectus* is compared with the chimpanzee's and orang utan's. Then follows a discussion of the frontal region in recent man, especially Negro races, and the fissural changes in this region in connexion with cytotectonic and functional fields, chiefly in the vicinity of the mid-frontal. The phenomena observed in fissural development in general are briefly discussed. With the anthropological differences in the brain, which doubtless occur, we should try to differentiate between brain variations primarily depending on, or at least correlated with, the skull and intrinsic changes in the brain.

Optical Society, May 12.—J. W. Perry: The  $F/1.8$  quartz monochromator-spectrograph. The circumstances in which large monochromators and spectrographs of especially high illuminating power are requisite are discussed, and the dependence of illuminating power and instrument efficiency upon the essential optical characteristics of such instruments is investigated. A description is given of a large instrument fulfilling the combined functions of monochromator and spectrograph, the relative aperture of which varies from  $F/1.6$  at  $0.185 \mu$  to  $F/2.0$  at  $1.2 \mu$ , and records of performance are described.—R. F. Hanstock: The transmission of light in diffusing media. The transmission of light by thin films of diffusing material is investigated, a flicker photometer being used for this purpose. The intensity  $I$  of the diffuse light transmitted in the direction normal to the surface is related to the film thickness  $x$  by the empirical equation

$$1/I = C(1 + ax + (ax)^2),$$

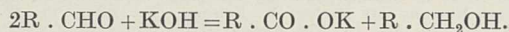
where  $a$  is a constant depending on the opacity of the material of the film to diffuse light and  $C$  is approximately constant for all substances. The ability of a film to hide a contrasting background is proportional to the quantity  $H = 1/I$ , complete hiding being attained for a value of  $H$  which is constant for a variety of white and coloured paints and papers. An accurate method of measuring the opacity or hiding power of such films is described.

## PARIS

Academy of Sciences, April 25.—Gabriel Bertrand and Mme. M. Rosenblatt: The unequal proportions of manganese in green leaves and etiolated leaves. Green leaves are richer in manganese than etiolated leaves.—R. Fosse, P. De Graeve, and P. E. Thomas: A new plant principle: uric acid. Uric acid has been extracted from various seeds (especially from *Melilotus officinalis*). It was identified by its crystalline form, by elementary analysis, and its reactions.—André Blondel: A new algebraical representation of alternating currents and of other oscillatory phenomena. The notation suggested facilitates rapidity of calculations and their physical interpretation in the applications of electricity and other oscillatory phenomena.—Louis Roy: The elastic line in the fundamental equations of the resistance of materials.—E. Kogbetliantz: The developments of Laguerre.—C. E. Winn: The convergence of a series derived from another series with limited variation.—Arnaud Denjoy: The continuity of singular analytical functions.—Michel Fekete: The number of changes of sign of a function in an interval and its moments.—de Séguier: The classes of substitutions of order 2 of linear, quadratic, Hermitian, and left groups in a Galois field of odd order.—N. Mouskhelichvili: The problem of torsion of compound elastic beams.—V. Smirnov and S. Soboloff: The plane problem of elastic vibrations.—B. Galerkin: The equilibrium of a thick circular plate in the form of a circular sector.—Alfred Rosenblatt: The stability of the Couette movements of viscous liquids.—R. Swyngedauw: The rational calculation of pulley belts.—R. Wavre: The extension of a theorem of Stokes relating to fluid stars.—D. Belorizky: The radius of convergence of the series in the problem of two bodies, treated by Levi-Civita's method.—P. Guintini: The distribution of the residual velocities of  $B$ -type stars.—J. Dufay: The energy curve of the star  $P$  Cygni. The energy curve of this star is not that of a black body.—Ch. H. Muntz: The resolution of the dynamical problem of elasticity.—Marcel Mennesson: A method of measuring lengths and thicknesses with high precision. Air under constant pressure flows through an orifice the section of which is a function of the length to be measured. The volume of air passed is determined by reading a length on a water manometer. A change of length of  $0.01$  mm. is thus amplified to  $500$  mm. on the manometer.—Pierre Vernotte: The measurement of the thermal conductivity of bad conductors: the calorimeter method.—Léon Grillet: The electrical conductivity of black paper. Applications.—M. Pauthenier and P. Delahaye: The electrostriction of benzene.—Charles Dietsch: A method of measuring high intensities of continuous current.—R. Chevallier: The magnetisation of macroscopic powders in weak fields.—R. Freymann: The absorption spectra of ethylene and benzene derivatives in the infra-red.—J. Rabinovitch: The rotatory dispersions of benzene solutions of  $d$ - $\alpha$ -pinene and  $l$ - $\beta$ -pinene. Correction to a preceding note.—Horia Hulubei: Contribution to the study of the Raman spectrum of water.—H. Buisson, C. Jausseran, and P. Rouard: The transparency of the lower atmosphere.—Mlle. Y. Cauchois: The spectrography of the  $X$ -rays by the transmission of a non-canalised pencil through a curved crystal.—Georges Fournier: The composition of atomic nuclei.—H. Barjot: The rational utilisation of solar heat.—D. Skobelzyn: The spectrum of the  $\gamma$ -rays derived from thorium.—Mlles. C. Chamié and A. Korveze: Centrifuging alkaline solutions of polonium.—Pierre Montagne: The formation of acetylene, starting with methane at low pressure, under the influence of condensed sparks. A study of the conditions (pressure of methane, capacity of condensers) giving the highest



yield of acetylene according to the equation  $2\text{CH}_4 = \text{C}_2\text{H}_2 + 3\text{H}_2$ .—H. Figour and P. Jacquet: Comparison of the electrolytic deposits of zinc and cadmium from the point of view of the protection of steel against corrosion. Zinc deposited from a sulphate bath is less resistant to corrosion than that deposited from a cyanide bath. The method of testing for corrosion is not a matter of indifference. Thus in a salt fog or in a wet warm atmosphere, cadmium protects steel better than zinc, but in outside air zinc is more resistant.—Georges Allard: The influence of substitutions on the frequencies of organic bodies.—Ch. Zinzadzé: The preparation of trimagnesium phosphate.—B. Bogitch: The principles of the treatment of nickel minerals.—L. Palfray, S. Sabetay, and Mlle. Denise Sontag: A method of determining aldehydes based on the reactions of Cannizzaro and of Claisen. The method is based on the reaction



On account of its high boiling point, benzyl alcohol is used as the solvent for the potash. The aromatic aldehydes have been proved to react quantitatively in the sense of the above equation.—M. Battegay and L. Denivelle: The chlorides of the arylsulphuric acids,  $\text{ArO} \cdot \text{SO}_2\text{Cl}$ .—P. Mognaud: The method of determining fluorine.—Jacques Duché: The action of ether and chloroform on the Actinomyces of the asteroid group.—R. J. Gautheret: The production of chlorophyll in roots exposed to light, especially in the root of barley.—Pierre Chouard and Georges Teissier: Relations between the growth of various parts of melon seedlings and the quantity of reserves left at the disposition of the embryo.—Charles Pérez: The small sexual differences of cuticular ornamentation in *Eupagurus*.—P. Vignon: The morphological explanation of the wings in the Diptera and Coleoptera.—A. Back and R. Legendre: The sexual state of *Germo alalonga* during the fishing season.—Mlle. Anne Raffy: The variations of dissolved oxygen consumption during the death of marine stenohaline fishes passing from fresh water to sea water.—Raoul M. May: The lasting action, as a substitute, of the intraocular graft of the thyroid from a newly born rat on the development of a white rat the thyroid of which had been removed.—A. Radöff: Researches on the stimulation of growth and of metabolism in the tissues of wheat. The acceleration of growth produced by a preliminary treatment of seeds with solutions of salts of certain metals (manganese, magnesium, zinc) has been proved (Popoff, Bertrand, Brenchley). Experiments on the metabolism of plants stimulated in this way confirmed the increase in growth, but gave negative results for increased metabolism.—Raymond-Hamet: The sympathicolytic poisons. The possibility of transforming, by a vaso-dilative action, the vaso-constrictive action of those amines not inverting the hypertensive action.

#### VIENNA

Academy of Sciences, Feb. 11.—Franz Ackerl: Force of gravity at the geoid.—Josef Norbert Dörr: The migration of birds and moonlight. In many cases it is difficult to observe any dependence of the times of the spring and autumn flights of birds on the meteorological conditions. Observations made over a long series of years in Austria, Hungary, France, Switzerland, etc., show that the main flights of those birds which are mainly night-migrants occur during the periods favoured by moonlight.—Fritz Wessely and Franz Lechner: 1:2:3:4-tetrahydroxybenzene derivatives. Synthesis of 6:7:8-trihydroxycoumarin and of dimethylfraxetin. An improved method of preparing 1:2:3:4-tetrahydroxybenzene, and also its conversion into 6:7:8-trihydroxycoumarin and

dimethylfraxetin, are described.—Leopold Schmid and Richard Huber: Colouring matter of *Papaver rhoeas*.—Carl Wirtz: Photometric observations with the great (67 cm.) refractor of the observatory at the University of Vienna. The observations described were made mostly on Saturn's system.—Joseph B. Niederl: The structure of acetone-cresol condensation products.—Heribert Grubitsch: The processes occurring during the galvanising of iron.—Wolfgang Gröbner: Minimal bases for the invariant bodies of cyclic and metacyclic permutation groups.—Eberhard Geyer: Short account of the anthropological results of the Lappland expedition of 1913-14 supported by the Vienna Academy of Sciences. The measurements made and the photographs taken during this expedition indicate mixing of the Lapps with their Scandinavian neighbours and with Asiatic (North Siberian) tribes.

Feb. 18.—Norbert Lichtenecker: Geomorphological investigations in the French Alps. A survey is given of the geological development of the French Alps.—Franz Lippay: Contraction of skeletal muscle during deficient formation of lactic acid. The large quantities of lactic acid regularly appearing during the permanent contraction of striped muscle are by some considered to bear a causal relationship to such contraction. The author's experimental results show that this is not the case, although the course of the contraction may be influenced by the lactic acid; the sense of such influence is, however, not the same with muscle contracted by means of chloroform as with muscle contracted by heat.—Franz Werner: Results of a zoological expedition to Morocco in 1930. (4) Orthoptera. More than ninety Moroccan species, ten of them not previously described, are discussed. The main work of the expedition consisted in revision of the Moroccan species from various difficult genera, such as *Hololampra*, *Pyrgomorpha*, *Acinipe*, and *Eury-paryphes*. A number of species were found on the Great Atlas Mountains at a height of more than 2500 metres.—Oswald Richter: New contributions to photosynthesis and photolysis, principally in living plants. By means of the so-called 'artificial high sun' (made by Messrs. Heräus of Hanau), which furnishes extraordinarily intense ultra-violet rays, particularly those of wave-length below 300 $\mu$ , a number of the effects of such rays have been studied. These include, for example, the decomposition of chlorophyll—which is easily effected in leaves of *Tropeolum majus*, *Robinia pseudacacia*, and *Iris florentina*—the hydrolysis of starch, the decomposition of anthocyan, necrosis colorations, etc.

#### Forthcoming Events

##### FRIDAY, JUNE 10

ROYAL ANTHROPOLOGICAL INSTITUTE (Sociological Research Meeting), at 4.—Dr. Fortes and others: Discussion on Cultural Stages.

ROYAL SOCIETY OF MEDICINE (Ophthalmology Section) (Annual General Meeting), at 5.—E. Clarke: Tay's Choroiditis.

ROYAL SOCIETY OF MEDICINE (Laryngology and Otology Sections) (at Eye and Ear Hospital, Portsmouth).—Summer Meeting (continued on June 11).

##### MONDAY, JUNE 13

MIDDLESEX HOSPITAL MEDICAL SCHOOL, at 5.—Dr. A. T. Wilson: The Physiology of the Adrenal Gland. (Succeeding Lecture on June 16.)

##### TUESDAY, JUNE 14

LONDON HOSPITAL MEDICAL COLLEGE, at 5.15.—Dr. J. R. Marrack: The Structure of Molecules in Relation to



- Biology and Medicine. (*Succeeding Lectures on June 16, 21, 23, 28, and 30.*)  
 EUGENICS SOCIETY (at Linnean Society), at 5.30.—Dr. A. S. Paterson: The Law of Anticipation in Mental Disease.  
 INSTITUTION OF PETROLEUM TECHNOLOGISTS (Special Summer Meeting) (at Royal Society of Arts), at 5.30.

## WEDNESDAY, JUNE 15

- RESEARCH DEFENCE SOCIETY (Annual General Meeting) (at London School of Hygiene and Tropical Medicine), at 3.—Sir Arthur Keith: Some Aspects of the Modern Conflict between Reason and Sentiment (Stephen Paget Memorial Lecture).  
 INSTITUTION OF MINING ENGINEERS (Summer Meeting) (at Sheffield) (*continued on June 16 and 17*).  
 ELECTROPLATERS' AND DEPOSITORS' TECHNICAL SOCIETY (at Northampton Polytechnic Institute).—Annual Election of Committee and Officers.

## THURSDAY, JUNE 16

- ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE (Annual General Meeting) (at Manson House, 26 Portland Place, W.1), at 8.—At 8.15.—Col. S. P. James, Prof. W. Schülemann, Prof. N. H. Swellengrebel, Dr. C. A. Henry, and others: Discussion on Synthetic Anti-Malarial Preparations and Quinine.

## FRIDAY, JUNE 17

- PHYSICAL SOCIETY (at Imperial College of Science and Technology), at 5.—Prof. Max Planck: The Concept of Causality in Physics (Guthrie Lecture).  
 ILLUMINATING ENGINEERING SOCIETY (Annual General Meeting) (at Royal Society of Arts), at 7.15.—Sir Francis Goodenough: Presidential Address.

## JUNE 16 TO 18

- ANNUAL COLLOID SYMPOSIUM (at Ottawa, Canada).

## Official Publications Received

## BRITISH

- Proceedings of the Royal Society of Victoria. Vol. 44 (New Series), Part 1, 29th February. Pp. iv+102+14 plates. (Melbourne.)  
 The Journal of the Indian Mathematical Society. Vol. 19, No. 7, February. Pp. 137-160+153-176. (Madras.) 1.8 rupees.  
 The Himalayan Journal: Records of the Himalayan Club. Edited by Kenneth Mason. Vol. 4, 1932. Pp. vi+225+v+22 plates. (Calcutta: Thacker's Press and Directories, Ltd.; London: W. Thacker and Co.) 5 rupees; 8s.  
 Indian Central Cotton Committee: Technological Laboratory. Technological Bulletin, Series A, No. 19: Application of Different Systems of High Draft Spinning to Mixings of Indian Cottons. By N. P. Richardson and Dr. Nazir Ahmad. Pp. ii+38. (Bombay.) 1.8 rupees.  
 Mines Department: Safety in Mines Research Board. Paper No. 74: International Conference on Safety in Mines at Buxton, 1931. Pp. 67+11 plates. (London: H.M. Stationery Office.) 1s. 6d. net.  
 Transactions and Proceedings of the New Zealand Institute. Vol. 62, Parts 3 and 4, March. Pp. xxiii+179-271. (Dunedin.)  
 The Scientific Proceedings of the Royal Dublin Society. Vol. 20 (N.S.), No. 18: A Critical Review of some Recent Work on the Occurrence of Virus Complexes in the Potato. By Dr. Paul A. Murphy. Pp. 193-210. 1s. 6d. Vol. 20 (N.S.), No. 20: The Compound Nature of Crinkle, and its Production by means of a Mixture of Viruses. By Dr. Paul A. Murphy and Robert M'Kay. Pp. 227-247+plates 10-12. 2s. 6d. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.)  
 Proceedings of the Society for Psychical Research. Part 124, Vol. 40, May. Pp. 363-387. (London: Society for Psychical Research.) 3s. 6d.  
 Education (Scotland). Report for the Year 1931, by the Director, on the Royal Scottish Museum, Edinburgh. Pp. 18. (Edinburgh.)  
 The Scientific Journal of the Royal College of Science. Vol. 2: containing Papers read during the Session 1931-1932, before the Imperial College Chemical Society, the Royal College of Science Natural History Society, the Royal College of Science Mathematical and Physical Society. Pp. 163. (London: Edward Arnold and Co.) 7s. 6d.  
 Journal of the Society of Glass Technology. Edited by Prof. W. E. S. Turner. Vol. 16, No. 61, March. Pp. xix+xii+32+110+138+xxv-xxiv. (Sheffield: The University.) 10s. 6d.  
 Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1441 (T. 3168): Investigation of Atmospheric Turbulence by Aircraft carrying Accelerometers. By W. G. Jennings, R. P. Alston and C. Howarth. Pp. 6+5 plates. 6d. net. No. 1446 (Strut. 44): Control Column giving Warning of Dangerous Wing Loads. By H. E. Wimperis. Pp. 6+1 plate. 6d. net. No. 1453 (T. 3186): The Interference on the Characteristics of an Aerofoil in a Wind Tunnel of Circular Section. By H. Glauert. Pp. 12. 9d. net. No. 1448 (T. 3122): Full Scale Lift and Drag Curves of a Standard Seaplane. By A. S. Crouch. Pp. 4+7 plates. 6d. net. (London: H.M. Stationery Office.)  
 Loughborough College, Leicestershire. Calendar, Session 1932-33. Pp. xvi+258+85 plates. (Loughborough.) 2s. 6d. net.

- British Science Guild. The Annual Report of the Council of Management, 1931-32, presented at the General Meeting of Members, held at the Royal Society of Arts, John Street, Adelphi, London, on Wednesday, 25th May 1932. Pp. 16. (London: British Science Guild.) 1s.  
 Canada: Department of Mines: Mines Branch. Investigations in Ore Dressing and Metallurgy (Testing and Research Laboratories) 1930. (No. 724.) Pp. iv+215. (Ottawa: F. A. Acland.)  
 Ontario Research Foundation. Report for the Year 1931 presented by the Chairman to the Lieutenant-Governor in Council, December 1931. Pp. 34. (Toronto: Herbert H. Ball.)  
 Publications of the Dominion Astrophysical Observatory, Victoria, B.C. Vol. 5, No. 1: The Radial Velocities of 523 O and B Type Stars obtained at Victoria, 1928-1929. By J. S. Plaskett and J. A. Pearce. Pp. 93. 25 cents. Vol. 5, No. 2: A Catalogue of the Radial Velocities of O and B Type Stars. By J. S. Plaskett and J. A. Pearce. Pp. 99-165. 25 cents. (Ottawa: F. A. Acland.)  
 Palaeontological Bulletin. Bulletin No. 1: The Tertiary Geology of East Gippsland, Victoria, as shown in Borings and Quarry Sections. By Fredk. Chapman and Irene Crespin. Pp. 15. (Melbourne: H. J. Green.)  
 Union of South Africa. Report of the South African Museum for the Year ended 31st December 1931. Pp. 19. (Pretoria: Government Printing Office.)

## FOREIGN

- Proceedings of the United States National Museum. Vol. 79, Art. 30: Design Areas in Oceania based on Specimens in the United States National Museum. By Herbert W. Krieger. (No. 2896.) Pp. 53+33 plates. Vol. 80, Art. 16: The Ancient Caves of Szechwan Province, China. By David Crockett Graham. (No. 2916.) Pp. 13+16 plates. Vol. 80, Art. 19: A Review of the Nematodes of the Genus *Hastospiculum*, with Descriptions of Two New Species. By B. G. Chitwood. (No. 2919.) Pp. 9+3 plates. Vol. 80, Art. 20: Records of Dipterous Insects of the Family Tachinidae reared by the late George Dimmock, with Description of One New Species and Notes on the Genus *Anetia* Robineau-Desvoidy. By J. M. Aldrich. (No. 2920.) Pp. 8. (Washington, D.C.: Government Printing Office.)  
 U.S. Department of Agriculture. Farmers' Bulletin No. 1691: How to Control Grasshoppers in Cereal and Forage Crops. By J. R. Parker and W. R. Walton and R. L. Shotwell. Pp. ii+14. 5 cents. Technical Bulletin No. 296: Feeding Punctures of Mirids and other Plant-sucking Insects and their Effect on Cotton. By W. V. King and W. S. Cook. Pp. 12. 5 cents. (Washington, D.C.: Government Printing Office.)  
 Annals of the Astrophysical Observatory of the Smithsonian Institution. Vol. 5. By C. G. Abbot, L. B. Aldrich and F. E. Fowle. (Publication No. 312L.) Pp. ix+295+11 plates. (Washington, D.C.: Government Printing Office.)  
 Bulletin of the American Museum of Natural History. Vol. 64: The Distribution of Bird-Life in Guatemala; a Contribution to a Study of the Origin of Central American Bird-Life. By Ludlow Griscom. Pp. ix+439. (New York City.)  
 The Physiology of Large Reptiles: with Special Reference to the Heat Production of Snakes, Turtles, Lizards and Alligators. By Francis G. Benedict. (Publication No. 425.) Pp. x+539. (Washington, D.C.: Carnegie Institution.)  
 University of Colorado Studies. Vol. 19, No. 2: Dominant Ideas in the Works of Guy de Maupassant. By Roy Alan Cox. Pp. 77-157. (Boulder, Colo.) 1 dollar.  
 The Science Reports of the Tôhoku Imperial University, Sendai, Japan. First Series (Mathematics, Physics, Chemistry). Vol. 21, No. 1, March. Pp. 192. (Tokyo and Sendai: Maruzen Co., Ltd.)  
 Journal of the Faculty of Engineering, Tokyo Imperial University. Vol. 20, No. 4: Stresses in a Plate with Two Holes, and the Examination of Cognate Problems. By Seinen Yokota. Pp. 99-118. (Tokyo: Maruzen Co., Ltd.)  
 Japanese Journal of Physics. Transactions and Abstracts, Vol. 7. Pp. v+46+46+3 plates. (Tokyo: National Research Council of Japan.)  
 Publications de l'Observatoire de Genève. Rapport sur les concours de réglage de chronomètres de l'année 1931. Pp. 27. (Genève.)  
 The Oriental Institute of the University of Chicago. In Commemoration of the dedication of the Oriental Institute Building, December fifth, 1931. Pp. iv+68. (Chicago.)  
 U.S. Department of the Interior: Geological Survey. Bulletin 827: A Geologic Reconnaissance of the Dennison Fork District, Alaska. By J. B. Mertie, Jr. Pp. iv+44+8 plates. 45 cents. Bulletin 830-A: Copper Deposits near Keating, Oregon. By James Gilluly. (Contributions to Economic Geology, 1931-32, Part 1.) Pp. ii+32+3 plates. 15 cents. Professional Paper 170-B: The Upper Cretaceous Ammonite Genus *Barroisiceras* in the United States. By John B. Reeside, Jr. (Shorter Contributions to General Geology, 1931.) Pp. ii+9-29+plates 3-10. 20 cents. Professional Paper 170-D: Pliocene Fossils from Limestone in Southern Florida. By Wendell C. Mansfield. (Shorter Contributions to General Geology, 1931.) Pp. ii+43-56+plates 14-18. 15 cents. (Washington, D.C.: Government Printing Office.)  
 Smithsonian Miscellaneous Collections. Vol. 87, No. 6: Composition of the Caddoan Linguistic Stock. By Alexander Lesser and Gene Wetflish. (Publication 3141.) Pp. 15. (Washington, D.C.: Smithsonian Institution.)  
 Nebraska Geological Survey. Bulletin 5, Second Series: Brachiopoda of the Pennsylvanian System in Nebraska. By Carl O. Dunbar and G. E. Condra. Pp. 434+44 plates. (Lincoln, Nebr.)

## CATALOGUES

- Watson's Microscope Record. No. 26, May. Pp. 24. (London: W. Watson and Sons, Ltd.)  
 Spectrograph of Great Intensity. (Lispec. 31.) Pp. 4. Analytical Balance in Brass Case (Improved Model). (Mac. 31.) Pp. 2. Vacuum Iron Arc Lamp for Spectroscopic Work. (Boog. 31.) Pp. 2. (Delft: P. J. Kipp en Zonen.)  
 Folklore and Anthropology. (Catalogue No. 549.) Pp. 74. (London: Francis Edwards, Ltd.)  
 Micro-Projection Apparatus. Pp. 8. (Manchester: Flatters and Garnett, Ltd.)  
 Gaster *Secata* B.D.H. (Desiccated Stomach.) Pp. 12. (London: The British Drug Houses, Ltd.)