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Birth Control and Human Biology.

FEW subjects are of greater social significance, or have aroused more violent opposition in recent years, than that of birth control. Since Dr. Marie Stopes started her energetic campaign ten years ago, she has had to contend with much misrepresentation, together with calumny from certain ecclesiastical quarters. It is gratifying to know, therefore, that on Mar. 17 a large and distinguished company assembled at the Ritz Hotel to congratulate her upon the success of her pioneer work for the benefit of the human race through the positive control of conception. A further indication of the growth of public opinion on the subject of birth control is given by the recent announcement from the Ministry of Health that contraceptive advice may be given in clinics controlled by local authorities, when it is desirable in the interests of health.

The society founded by Dr. Stopes has the title "Constructive Birth Control" and she rightly insists on the word "constructive". By this Dr. Stopes means that her aim is not only to prevent children being born to poor and unhealthy parents, but also to bring the joys of parenthood to sterile couples who desire children and have the means to support them. This part of the work of "Constructive Birth Control" must, however, always constitute a very small proportion of the whole; by far the greatest task is that of preventing undesirable births.

Now, the means of preventing births—leaving out the illegal and dangerous method of abortion—resolve themselves in two categories, namely: (1) prevention of the dehiscence of the eggs, and (2) immobilisation or destruction of the spermatozoa. Until recent years methods of the latter kind only have been adopted, and to many people these methods seem disgusting and destructive of all the romance of sexual congress. We are, however, coming in sight of much simpler and unobjectionable methods; there is hope of being able to prevent by means of the injection of an extract of pituitary gland the dehiscence of the eggs altogether. This injection can be made anywhere on the body, and its effect will last for a whole menstrual period.

It is obvious that if the efficacy of the new method referred to can be confirmed and its mode of application standardised, sentimental objections to birth control will disappear: there will remain only the 'moral' and ecclesiastical ones, and on the ecclesiastical objections a word or two

may be said in the interests of clear thinking and accurate history. Whatever weight there may be in these objections, they derive no support whatever from the recorded sayings of the Founder of Christianity or from those writings of His great apostle Paul which are most widely accepted as genuine. For, from the sayings of Jesus and the writings of Paul, it is clear that both held the view that the present order of Nature would be terminated after a brief period of about forty or fifty years and be replaced by a supernatural order miraculously introduced from heaven, which would establish the "kingdom of God", in which there would be "neither marrying nor giving in marriage". In the meantime, marriage was legal as a concession to the flesh; but it was futile and "it remaineth that those with wives should be as those that had none". With an outlook on life and the future of the world so totally different from our modern one, the question of the necessity of birth control could never have presented itself to early spiritual teachers.

Dr. Stopes was led to advocate birth control from observation of the misery, pain, and disease caused by the overbreeding of the poor. Many ladies of great refinement and initial prejudice against birth control have been driven to the same conclusion as Dr. Stopes, from the same cause. In her book, "The First 5000", Dr. Stopes has given heartbreaking accounts of women looking like old hags at the age of thirty-five, never free from pain, having forgotten what normal good health means, who, when examined in her clinic, have been discovered to be suffering from displaced wombs, lacerated cervices, and other injuries. Such women frequently had histories of annual confinements often resulting in still-births; and indeed, from the condition of the womb, it was difficult to see how any other result was to be expected.

It has been objected that only unhealthy women would visit the clinic, and that the great majority of working-class mothers remain healthy and strong in spite of having had large families: in fact, it has been contended that in a normal woman, child-bearing, instead of injuring, actually promotes health. It may be that Dr. Stopes has drawn too dark a picture, but it must be remembered that Dr. Jansen—a leading Dutch authority on maternity and heredity—in a book entitled "Feebleness of Growth", comes to the conclusion that, in cases where the influences of alcohol and of venereal disease could be excluded, the members of large families showed a progressive deterioration in size and strength as births succeeded one another. This deterioration was not due to any inherent differences in the germs; for when, as in some cases, one or two children died in early infancy, the next surviving child was actually stronger than the last one, showing that the real cause of the deterioration was the exhaustion of the mother. But, however important these humanitarian considerations may be, and however much all kindly-disposed persons must sympathise with Dr. Stopes in her fight against misery and pain in her own sex, there are biological arguments in favour of birth control which enormously outweigh the philanthropic ones and in our opinion erect the question of birth control into the most urgent and important problem of modern times.

Dr. Elton, in his charming text-book on "Animal Ecology", puts the problem most clearly by pointing out that if the numbers of a species are to remain constant, the number of offspring which survive their parents must not exceed two. But every known species produces far more offspring than this. Suppose now the conditions of the environment to become temporarily more favourable and that three children survive each pair of parents. This would mean an increase in the population of 50 per cent in one generation. If we represent the original population as 100 and the same increase continued for another generation, the population would increase by 50 per cent over 150: that is, it would reach the figure of 225 and be more than doubled in three generations. It is easily seen that in these circumstances the numbers of the species would rapidly attain the dimensions of a plague; and, as Dr. Elton shows, at this point a mad impulse to migration sweeps over it, and in rapidly breeding animals like rodents these crises tend to occur at intervals of ten to eleven years.

Dr. Uvarov has proved that the devastating swarms of migratory locusts develop at intervals out of populations of apparently harmless grasshoppers when owing to the climate in some particular year an unusually large number of eggs hatch out. The same thing has been observed in fish. After the method had been elaborated of determining the age of fish by counting the rings of growth on their scales, the surprising discovery was made that the herring hatched in a particular year had constituted the bulk of the catch for a long period of years. When the matter was inquired into, it was found that the number of eggs spawned in that particular year was not greater than normal, but that owing to the coincidence of the spawning and of a particularly abundant crop of diatoms, far more herrings than usual had survived their

babyhood, so that what had increased was not the *birth-rate* but the *survival-rate*.

Now, all these phenomena, namely, an increase in survival-rate, the consequent abnormal increase in population, and mass migration, have occurred time and again in the human race. They are consistently ignored because, man being a slower breeder than most animals, they occur at long intervals and several generations may elapse without their making themselves felt. During Classical and Middle Ages there were breeding grounds of hardy, virile races from which swarms of young men issued forth to plunder their civilised neighbours. Sometimes these swarms developed into mass migrations, bringing women and children with them. Such breeding grounds were the lands surrounding the Baltic, the peninsula of Arabia, and the steppes of central Asia. Quite obviously, all three regions were incapable of supporting an increasing population, and when the alternatives starvation or migration were presented to them, the sturdy inhabitants invariably chose the latter. Nothing more terrible than the Tartar invasions of Mesopotamia, Syria, and Egypt has occurred during human history. It may be argued that with the perfection of modern weapons and modern transport such dangers have become things of the past. That is partly true; civilised countries are no longer likely to be overrun by hordes of hungry barbarians. But the cause of these invasions, the tension of an ever-increasing population, continues to operate and will certainly produce disturbances almost equally as formidable as the Tartar invasions.

If we take our own country, we find that in 1600 the population of England and Wales was about 5,000,000; in 1700 it was 5½ million, in 1800 it was 9,000,000, and in 1900 it was more than 30,000,000. The enormous increase in the nineteenth century is usually ascribed to the 'industrial revolution': that is, the introduction of machinery driven by steam for manufacture. This, it is argued, provided far more openings for employment, and consequently the poor produced more children. But Miss Buer ("Health, Wealth, and Population—the Early Days of the Industrial Revolution") shows that this is a mistaken deduction. The increase in population began before the 'revolution': the birth-rate did not increase to any marked extent, but the *survival-rate* increased owing to the introduction of vaccination, modern sanitation, and a purer water supply. From 1880 onwards, the birth-rate began to fall, owing to the introduction of birth control methods amongst the well-to-do; but until the present day it remains undiminished amongst the lowest and least-skilled section of the population. By our grandmotherly system of doles, maternity benefit, etc., we are doing our best to encourage it. Forty years ago, this section of the population bred as it does now, but the great majority of the children died. To-day, however stupid, they survive and constitute an increasing proportion of the future nation.

Before the War, the increase in population was to a considerable extent relieved by emigration to the Dominions and the United States. To-day that door is closed; the United States will admit annually only a small quota, and the Dominions, for the present at least, none. England at the moment resembles a steam-boiler with an increasing pressure and no safety-valve. In Italy, Signor Mussolini is encouraging large families with the view of increasing the importance of the Italian nation. By his skilful development of the natural resources of Italy, room is at present being made for the increase. But it is obvious that this process will soon reach its limit, and then Italy will become another dangerous centre of tension.

The recent census of India revealed that an increase in the population from 320,000,000 to 350,000,000 has taken place in ten years. The Indian peasant always lives on the barest minimum of subsistence, which is all that can be wrung from his small plot of land. It makes one shudder to think of the intensification of that dull, sordid struggle and the consequent misery involved in the necessity of feeding 30,000,000 extra mouths. A distinguished Anglo-Indian friend once told us that in one of the islands of the Ganges delta three-quarters of the population were wiped out by an inundation; ten years later that island was distinguished by its prosperity over all the other parts of the delta. No wonder some cynics sigh for the good old days when, at intervals, life was diversified by plagues and invasions which produced temporary excitement and discomfort and relieved the pressure of population. This pressure is one of the results of British rule and British humanitarian sentiment.

Humanitarian sentiment acting in ignorance of the laws of biology is a most dangerous thing and produces devastating results. Compulsory birth control seems to us to be the only remedy capable of averting these results. Truly, though hardness of heart be given divine condemnation, Nature is equally severe on stupidity and wilful ignorance.

E. W. MacBride.

The Rise and Growth of Applied Entomology.

Smithsonian Miscellaneous Collections. Vol. 84: *A History of Applied Entomology (somewhat Anecdotal).* By L. O. Howard. (Publication 3065.) Pp. viii + 564 + 51 plates. (Washington, D.C.: Smithsonian Institution, 1930.)

THE title of this volume suggests a severely technical contribution. It is, in fact, a technical contribution, but one leavened with anecdotal and humorous facts and foibles respecting personalities that figure in its pages. It traces the rise and growth of applied entomology very largely through the lives of those whose efforts have built up the subject. The document before us is, in consequence, of a very human interest, and in its author we have the doyen of the world's economic entomologists. Dr. Howard's long career as Chief of the United States Bureau of Entomology renders him exceptionally well qualified for the task of writing this book. Probably no one else has established so many personal contacts with entomologists from all over the world. His own travels, so often over North America and into Mexico, and in many European countries, have enabled him to learn much about conditions first-hand. Further, Dr. Howard's office in Washington has long been the Mecca of all entomologists who sought to widen their experience by visiting such American organisations as he advised. In his retirement he has made good use of his time by placing on permanent record a rich harvest of facts and impressions gleaned from innumerable sources.

This volume is largely divided up geographically into separate parts and, as stated in the preface, it is not a history of the strict, modern, documented type. In Part I. (pp. 9-198), Dr. Howard traces the various factors and influences that have led to the great development of his subject in North America. Much is related concerning the lives of the early American exponents of economic entomology, their individual traits and how each person influenced the trend of events. A good deal is told about individuals and circumstances which we do not recollect having seen in print before. As isolated reminiscences these records are merely interesting, but when woven into an historical fabric of this kind, they help to recast a proper perspective of times now gone by. Dr. Howard extends just praise where it is due, yet the foibles of individuals are not overlooked, and he manages to incorporate much that is entertaining in an anecdotal way. Individuals make institutions, and among the latter the leading State, Federal, and non-official organisations are explained and their developments followed.

The inauguration of journals and of societies comes in for its share of recognition, and their metamorphoses are followed up to the present day. The teaching of economic entomology, from its early beginnings up to the great modern schools at Cornell and elsewhere, is recounted: teachers and their methods are characterised, while, here and there, something pertaining to their audiences finds expression. The major campaigns of insect control in the United States are discussed in an interesting and informal manner: quarantine and other acts come in for historical record and their consequences clearly indicated. Public expenditure, political events, and also the salaries of entomologists, all come under review. Canada and Mexico find their due places in this section of the volume. An exceptionally full account is given of applied entomology in Mexico, possibly because it is so little known; and here it seems perhaps a little anomalous that the more extensive, and older, developments in Canada are discussed in the same number of pages.

Dr. Howard concludes that the enormous damage incurred by insects demands many more men to cope with it in America, even more than in any other part of the world. "Surely", he says, "we appreciate their need more than any other country. And that is the reason why the United States stands at the head in applied entomology."

Part II. (pp. 201-336) deals with European countries. It opens with sections on the early writers and their work, and then passes on to discuss at length the effects of the entry of the *Phylloxera* on to the Continent. It would seem, Dr. Howard says, that this pest proved a blessing in disguise, for the reason that serious work in applied entomology originated very largely in some countries as the result of the check to viticulture administered by this insect. He then proceeds with his main subject, taking it country by country. The early struggles that applied entomology underwent in order to obtain recognition in the British Isles are admirably followed. When we come to later developments, we find an appreciation of the work of the Imperial Bureau of Entomology, and due compliment is paid to the world-wide value of its publications. Reference will also be found to the influence of the Development Commission, the Empire Marketing Board, Carnegie studentships, and other organisations that have tended so much to the furtherance of the subject.

In dealing with France, the development of the State organisations is traced, and a special section is devoted to personalia with respect to the savant Paul Marchal and the outstanding work accomplished by him. Similarly, when we come to Italy, we find just tribute paid to F. Silvestri, who is, perhaps, the most learned and experienced general entomologist to-day. The accounts of developments in Russia and Poland are particularly enlightening, and Dr. Howard's visits to both these countries have enabled him to garner information from personal experience. So each country is taken *seriatim*, and there are not many that our author has not visited at one time or another, often on several occasions. He is thus able to impart much that is both interesting and significant respecting its leading applied entomologists in every story. Even Cyprus, its problems, and its young Government entomologist find a place in this section of the volume.

Parts III. to VI. (pp. 339-462) are concerned respectively with Asia, Africa, Australasia, and Central and South America. Here, a good deal that is unfamiliar is placed on record, and many little-known persons are brought into the limelight and their services appraised. Most of us know little as to what has gone on in Uruguay, Guam, or Haiti, for example, but Dr. Howard has dispelled this ignorance with many interesting facts respecting both persons and institutions in such parts of the world.

Part VII. (pp. 465-545) is mainly concerned with the growth and development that medical entomology has undergone during the last fifty years. Dr. Howard's own early medical training has given him a lien towards this aspect of insect control. By means of his writings and his personal influence, he has done inestimable service in making discoveries widely known, and in moulding American public opinion into realising the menace of insect-borne diseases. This part of the volume is rich in personalia, and we find therein many reminiscences of such leaders as Ross, Blanchard, Grassi, and others, too many for separate mention. Biological control, also, has its place in this part: the history of the practical utilisation of parasitic and predatory insects is traced, and what has been achieved by way of biological control in different countries recounted. The three concluding sections of Part VII. are short but to the point. In one, the growth of the appreciation of applied entomology by other scientific workers is discussed and analysed. This is followed by a numerical comparison of applied entomological literature that has emanated from different countries, and it appears that, in less than fourteen years, no fewer than 23,430 papers and books on the subject have appeared in the world! Finally, Dr. Howard has some cogent remarks on the future outlook for the control of insect pests.

At the end of the volume are 51 half-tone plates which contain about 250 portraits of applied entomologists who have contributed, or are still contributing, to the advance of their subject. The originals of many of these are in the unique collection that Dr. Howard has gathered together and filed in Washington over a long period. Many visitors from afar have faced the camera at his instigation, but few realised that they were destined to feature in the present volume! Following the plates is an 18 pp. index listing more than 5000 names of individuals that are mentioned in the text of this volume: all, in some way or other, have exercised influence upon applied entomology.

We must conclude this notice by extending our gratitude to Dr. Howard for giving us quite a monumental volume. It is one wherein his own inimitable personal touch has imparted to it a character not only unique and entertaining, but also of enduring interest as an historical record.

A. D. Imms.

Scientific Aspects of Disarmament.

Scientific Disarmament: a Treatment based on the Facts of Armament. By Victor Lefebure. Pp. 320. (London: Mundanus, Ltd., 1931.) 5*s.* net.

In the numerous discussions on disarmament during the last twelve years, the ethical and moral aspects have been emphasised out of all proportion to the other factors. The moral aspect of war has been debated for centuries, but has essentially no relation to the problem of disarmament as it presents itself to-day. Even if we take the Quaker point of view, we cannot afford to wait for the spiritual conversion of whole nations, civilised and uncivilised, to the same doctrine of non-violence. There is nothing in history which justifies our relying upon such a transformation for the solution of an urgent and acutely dangerous problem. It is indeed this failure to visualise disarmament as essentially a practical problem for our own generation that has led to so much dissipation of genuine moral support into sterile and unprofitable channels. Had the energy diffused among a score of peace societies of one type or other been concentrated in definite support and

constructive criticism of the efforts of the League of Nations in this field, there would undoubtedly have been far greater advances towards disarmament. As it is, our failure to grapple with the facts of disarmament still allows politicians, embarrassed by the conditional disarmament of Germany under the Treaty of Versailles but unwilling to make a positive contribution themselves, to find an easy refuge in moral and economic platitudes.

Disarmament presents itself at the moment as essentially a political and a technical problem, and on the whole the emphasis is on the technical aspect. The extent to which the Pact of Paris has changed the fundamental situation is as yet scarcely perceived, and once the logical sequence of the fact—the renunciation of neutrality—has been publicly recognised by the Great Powers, the political situation should no longer offer any real obstacles to progress. Indeed, the acceptance of this principle by the United States of America would probably be decisive.

On the technical side, it is significant that the study of disarmament which has already been carried out by the League of Nations has demonstrated that disarmament is a practical proposition, and discussion now centres not on the possibility but on the mechanism of disarmament. To this discussion, Major Lefebure's volume makes a contribution of fundamental importance. Disarmament is largely a technical matter. Its successful treatment depends on the impartial analysis of all the relevant facts. The failure or halting progress of most efforts in the field of disarmament has been mainly due to failure to visualise clearly the main objective, and as a result to treatment of the problem in fractions. "Scientific Disarmament" gives us essentially a projection of scientific method into the disarmament problem—the application of those principles of observation, analysis, and deduction upon which are based all the advances of pure and applied science.

Starting with the assumption—to-day a definite principle of international policy—that we can no longer afford to settle our national disputes by war, Major Lefebure views disarmament as essentially the problem of securing sufficient periods of time free from hostilities for the success of the alternative methods of peaceful settlement. Before any practical steps can be taken, a really thorough and informed exploration of technical disarmament must be undertaken, and the main purpose of the book is to urge the necessity of such an investigation. Without it the efforts of the Disarmament Conference, to be held in 1932, are likely to be fruitless, and failure of such a world conference would seriously prejudice the cause of disarmament for years.

Ten years ago, in "The Riddle of the Rhine", Major Lefebure established the vital relation between chemical warfare and industry, and exposed both the fallacy of a disarmament policy which ignored the new agencies of war, and the futility of the abolition of chemical warfare without the elaboration of definite measures of control. Industrial developments during the last decade have reduced some of the disparity between the chemical industries of the Great Powers, but in the discussions on disarmament chemical warfare has received cursory or only sentimental treatment. In spite, however, of the intricate relations between the various agencies of chemical warfare and chemical industry, the conceptions of armament potential and of conversion lag operate as effectively as in other fields. If our normal productive capacity is sufficiently low, the time characteristics of the production of armaments of every type involve a delay of anything from six to eighteen months, which renders quantity limitation a feasible and valuable disarmament measure. Great stocks of war chemicals used in industry have no meaning for war unless the appropriate containers or chemical weapons have been designed.

The soundness of this argument will be appreciated by all who have been concerned with industrial development or expansion, but the question of type is equally important. The facts advanced by Major Lefebure indicate that agreement on the types of armament to be retained and limited, and the suppression of all other existing types, is also an essential condition of efficient disarmament. The existence of private manufacture and traffic in arms appears to be inconsistent in a genuine scheme for disarmament. Even an investigation such as that contemplated by Major Lefebure, however, will require much publicity and very emphatic support from public opinion before its recommendations on these questions of armament types, the traffic and manufacture of arms and of combatant conversion involved in the conscription issue, are accepted in the face of opposition which can well be imagined.

A significant fact in the history of armaments is the failure of military authorities to recognise the importance of new types of armament. The extent to which chemical warfare dominates the armament field is even yet not generally realised, and it is doubtful whether even military or naval opinion appreciates the degree to which the new agencies

of war have increased not only its deadliness but also the difficulty of forecasting its issue. Security is now conditional upon disarmament. In such circumstances, uninformed action may create an invisible disparity of armament which may lead to war through encouraging some nation to believe in the possibility of its overwhelming success. The only disarmament policy which can hold out any hope of success is one based not on opinions but on scientific investigation of the facts which can be ascertained, and on scientific control of the critical technical factors involved. Until such a scientific policy has been elaborated, the political factors are largely irrelevant. Once in possession of a scientific policy that is technically sound, the hitherto ineffective moral and ethical forces can be marshalled to overcome any lingering opposition in the political field.

We may admit that the application of science has made warfare too dangerous an instrument to be used in national policy, but it is equally true, as Major Lefebure reminds us, that science holds the key to disarmament. The problems of control are not insoluble and will yield to treatment along scientific lines. The elaboration of a scientific disarmament policy is a task in which scientific workers can help, and is urgent and essential if civilisation is to regain control over the destructive powers released by the application of scientific discoveries. A study of disarmament is an integral part of that scientific study of international affairs through which alone can ultimately evolve the logical requirement of the Pact of Paris—a science of peace.

Positive Rays.

Canalstrahlen. Von E. Goldstein. (Herausgegeben von E. Gehrcke.) (Ostwalds Klassiker der exakten Wissenschaften, Nr. 231.) Pp. iv + 86. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1930.) 4·80 gold marks.

THIS selection of the late Prof. Goldstein's papers, on positive rays and the cathode glow, is reprinted with only two trivial alterations, both due to Goldstein himself. One cannot but admire the accuracy of his observations, especially in the first paper (1886), the ultimate outcome of which is now the mass-spectrograph and the two main methods—Brose's and Stark's—for the electrical resolution of spectra.

At the same time, it must be admitted that a great deal which Goldstein described has yet to be fully explained, in particular, the origin of the light which appears on the cathode surface inside the Crookes's dark space, and the exact nature of the curious small bulbs of light which form at a hole in the cathode, or at its side, when the discharge strikes to the back of this electrode. Goldstein was careful to point out that the former had probably a dual origin, some of the rays to which it was due coming from the cathode and some going towards it, but the elucidation of conditions at the cathode surface remains one of the major problems in connexion with discharge tubes. The position with regard to the bulbs is also obscure; it is known that tubes exhibiting them often, if not invariably, act as generators of high-frequency oscillations, but there is no explanation of why this should be so, or even a satisfactory electrical description of the bulbs, whether they are local concentrations of positive rays or local discharges of an arc type.

It is interesting to notice that Goldstein gave the correct explanation of the repulsion of the discharge from the walls in the dark space, and of its attraction in the negative glow (in the dark space, he supposed that the walls acted as an anode, and in the negative glow as a cathode), and also that he came near to discovering Brown and Thomson's shadow method for finding potentials in the dark space. The least satisfactory sections of the reprints are those dealing with the ray patterns that form on polygonal cathodes, where he has succumbed to the temptation, always present in discharge work, to spend time on phenomena which are rather beautiful and probably not of much fundamental importance.

The publication of these papers in book form is a considerable convenience to anyone interested in research on the glow-discharge, as well as an appropriate supplement to von Traubenberg's appreciation of Goldstein in last year's *Die Naturwissenschaften*. K. G. E.

Our Bookshelf.

A History of Modern Culture: the Great Renewal, 1543–1687. By Prof. Preserved Smith. Pp. xi + 672. (London: George Routledge and Sons, Ltd., 1930.) 12*s.* 6*d.* net.

SEEKING as we do in these pages for every manifestation of the new spirit in the conception of history, we welcome with especial warmth the first volume of Prof. Preserved Smith's "History of Modern Culture". Here is an author who opens his account of the seventeenth century boldly by saying that "of all the forces moulding modern life, science has been the greatest. It can be shown that all other changes in society are largely dependent upon this." We have just said 'seventeenth century',

but the author himself is careful to extend his limits on the earlier side to 1543, and calls his period 'The Great Renewal', which he thinks we should interpose between Renaissance and Reformation which precede it, and the enlightenment which follows in the eighteenth century. Whatever we may think of this division, it has the great advantage of including at one end the work of Copernicus and Vesalius and at the other the foundation of the Newtonian system, with Galileo and his fight with the Inquisition in the central point.

The sciences thus form the subject of Part 1 of the book, the humanities of Part 2; social control, which includes education, religion, and law, Part 3; while literature, art, and morals find their way together into Part 4, called the "Spirit of the Times". This arrangement might, no doubt, be improved, and it is disconcerting to find a full and admirable chapter on the arts, to say nothing of literature, inserted as an item in the "Characteristics of the Times".

On the matter, the only comment we feel inclined to make is that Prof. Smith looks at the culture or civilisation of his period rather too exclusively through the eyes of the writers of books and the painters of pictures. One would like to hear more of what the common people did and thought, and how they lived and moved in the period. On this side, G. N. Clark's recent work on the seventeenth century is an interesting contrast. But as a history of thought, Prof. Smith's book is easily the best we have seen. F. S. M.

Wit and Wisdom in Morocco: a Study of Native Proverbs. By Dr. Edward Westermarck, with the assistance of Shereef Abd-es-Salām el-Baqqālī. Pp. xi + 448. (London: George Routledge and Sons, Ltd., 1930.) 25*s.* net.

IN this volume, Prof. Westermarck completes his trilogy on Moroccan customs and ideas. The three books, "Marriage Customs in Morocco" (1914), "Ritual and Belief in Morocco" (1926), and "Wit and Wisdom in Morocco", are the fruit of nine years' experience of the country and its people, spread over a period of three decades. In the two earlier works, Prof. Westermarck showed to what advantage he had turned his opportunities for observation; from the last we are in even a better position to judge what a wealth of intimate knowledge of the psychology of the people and of their everyday life lay behind his interpretation of custom and belief in the earlier studies.

The author has here given the literal translation, with explanatory comments, of a large number of proverbs classified under subjects and the text in Arabic script. It may be remarked in passing that there are considerable differences between the written and spoken language, which the author sets forth in detail. An introductory essay deals elaborately with the form and content of the proverb, and discusses at some length its significance as an index to the character and culture of the people. Prof. Westermarck points out that the Moroccan proverb shows very marked traces of the influence of Islam, especially in its attitude to women. On the other hand, he adds a much-needed word of caution as to the employment of the proverb in diagnosing the prominence or absence of any given feature. The fast of Ramadan, for example, is not even mentioned in any proverb. To conclude that it was therefore of no importance or significance in Morocco would be entirely erroneous, as it is rigorously observed.

Collected Geometrical Papers. By Prof. Syamadas Mukhopadyaya. Part 1. Pp. viii + 157. (Calcutta: Calcutta University Press, 1929.) 4 rupees.

THE papers in this collection number ten on plane curves and seven on non-Euclidean, mainly hyperbolic geometry. The papers of the first group include six dealing with such topics as the geometrical theory of a plane non-cyclic arc, cyclic and sextactic points, and a generalised form of Böhmer's theorem, in which methods of pure geometry are employed, in several cases new methods of considerable interest. In this group, there are also four papers on the general theory of osculating conics, in which the methods of differential geometry are applied in rather a novel manner. The papers of the second group also offer some new features, and amongst a number of interesting results may be noted an extension of the well-known correspondence between a right-angled triangle and a three-right-angled quadrilateral in hyperbolic geometry, so as to include a regular pentagon. The book can be recommended to all who are interested in geometry, whether Euclidean or not, and wish to learn something of the progress of geometrical studies in Indian universities.

The Papyrus Ebers. Translated from the German Version by Cyril P. Bryan. Pp. xl + 167 + 8 plates. (London: Geoffrey Bles, 1930.) 10*s.* 6*d.* net.

LEST intending readers may be disappointed, we hasten to inform them at the outset that this book is not a translation in the usual sense of the German version of the famous medical papyrus obtained in Egypt by Ebers in 1870. It is, in fact, a running commentary with a selection only of some of the medical formulæ or prescriptions taken from "the oldest book in the world"—it dates from 1500 B.C.—and classified according to their subject matter: diseases of the alimentary system, minor medicine, minor surgery, the urinary system; diseases of women, of the skin, eye, ear, nose, and throat, and so forth. In a few cases only does the author quote the magical invocations which played such a prominent part in the healing art of ancient Egypt.

Nevertheless, the prescriptions themselves are a remarkable collection, as exemplifying the curious and bizarre forms assumed by the magical idea. The chapters containing the actual prescriptions are preceded by others which deal with the age, history, and form of the papyrus; the pharmacopœia; the mineral, plant, and organic materials

used; and the relations of the gods to disease. Prof. Elliot Smith has contributed an introduction, in which he briefly reviews the progress of the study of the pathology of ancient Egypt, to which he himself has made no small contribution during the last thirty years, and, secondly, points out the value of the Ebers papyrus as a basis for the comparative study of folk-medicine, quoting as an example the use of the mouse in folk-healing, which is found in ancient Egypt and survives in England to-day.

Differential Equations. By Dr. Forest Ray Moulton. Pp. xv + 395. (New York: The Macmillan Co., 1930.) 24*s.* net.

Dr. Moulton's book is written on a novel plan, in so far as no attempt is made to cover the whole field of differential equations. Elementary methods of solution of standard types of equations, singular solutions, solutions by definite integrals, and partial differential equations are omitted altogether; but general classes of ordinary differential equations, the nature of their solutions and integrals, and general methods of determining them are treated fully and with unusual rigour.

There are very complete accounts of the method of variation of parameters, the method of successive integration, including its application to the numerical solution of equations, and the Cauchy-Lipschütz process. Linear differential equations, with constant and periodic coefficients, are considered fully, particular attention being paid to the cases of multiple roots of the characteristic and fundamental equations. Finally, there is a chapter on differential equations with an infinite number of variables with astronomical applications. The general theory is illustrated by applications to specific problems, including elliptic motion, the sine-amplitude function, the deviations of falling bodies, and the damped gyroscope.

The book is not one for the beginner, but can be highly recommended to the advanced student who seeks information on the general methods of solution of the types of equations treated, as well as to the astronomer and mathematical physicist who need to apply these methods to particular equations met with in their researches.

The Annual of the British School at Athens. No. 29, Session 1927–1928. Pp. x + 351 + 25 plates. (London: Macmillan and Co., Ltd., n.d.) 63*s.* net.

The twenty-ninth Annual of the British School of Archæology in Athens covers the operations of the School for the session 1927–28, when the major excavation at the temple of Artemis Orthia at Sparta was in the nature of a final clear-up. The director, Mr. A. M. Woodward, therefore devotes himself to a report on the remainder of the inscriptions, mostly of office-holders, and, with M. L. Robert, discusses at some length four Hellenistic decrees, of which the number found elsewhere at Sparta is exiguous. These deal with a proxeny conferred on a Spartan by Arcadian Orchomenos, decrees in favour of Spartan dicasts by Eretria and Demetrius in Thessaly, and an incomplete decree of Tralles. Mrs. Woodward deals with an interesting group of archaic terra-cottas from the Acropolis, presumably votive offerings to Athena Chalkioikos or the warlike Aphrodite, whose temple was behind the Chalkioikos. Mr. W. A. Heurtley, assistant director, has continued his work on outlying early sites, and describes the excavation of two mounds situated in Chalkidike with settlements of the neolithic and bronze ages, which are compared with sites previously excavated by the School at Vardaróftsa.

School Botany. By Dr. Macgregor Skene. Pp. vii + 243. (Oxford: Clarendon Press; London: Oxford University Press, 1931.) 3*s.* 6*d.*

Many teachers of biology are opposed to the introduction of botany and zoology as separate subjects in the school curriculum before the age of specialisation, the higher certificate phase. Nevertheless, there are still plenty of syllabuses of botany designed for matriculation examinations, and it is this standard of work which Dr. Skene has had in mind in preparing his "School Botany". Whether many of these syllabuses can be said to be 'covered' by reference to the flowering plant alone is open to doubt. But flouting the examination bogy and taking the book on its merits, as matter for profitable study, it attains distinction in its class. The treatment is practical from beginning to end, the plants are really live things, whether in the laboratory or in the field; and so clearly is it expressed that a pupil could do much useful work with very little supervision. The style flows easily, contact is made with the historical aspect as well as with the other branches of science, and the illustrations are few but good. The book can be specially recommended for use with groups of boys or girls of any secondary school age as part of their general education or as the subject of a holiday task.

The Dissection of the Frog. By Dr. R. H. Whitehouse and Dr. A. J. Grove. Pp. x + 101. (London: University Tutorial Press, Ltd., 1930.) 2*s.*

The type system in anatomical teaching is an unconscionable long time dying, and the frog remains an incongruous figure in the centre of the system. Every young anatomist learns that the frog is the type of types, and that every other creature is either a 'lower' type or a 'higher' type. Yet the frog is but an aberrant amphibian, far from the main stream of evolution, and were it not for its convenient size, widespread occurrence, and prolific breeding, it would probably have been overlooked by the selectors of types. This is no disparagement of the very compact little book under review, which, in fact, contains a great deal of useful advice about laboratory practice in addition to a clear exposition of the anatomy of the frog. The authors hold out high ideals for the teacher, for the student, and for the work of the class. If the time factor makes it impossible to carry out their ideals in the letter, the spirit should result in the replacement of much ineffectual copying by honest thinking.

Letters to the Editor.

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

The Theory of Geological Thermal Cycles.

IN a review of the second edition of Prof. J. Joly's "Surface History of the Earth" (NATURE, Feb. 14, p. 227) Prof. A. Holmes makes the rather sweeping statement that the proposed mechanism for the alternating accumulation and discharge of heat seems to be physically unacceptable. He appears to justify this view from Dr. Jeffreys' opinion, who originally based his condemnation of the theory on the fact that there is no periodic solution to the equation giving the heat flow in a solid medium. When, however, change of state occurs in the medium, we have to allow both for the motion of the medium itself and also for the latent heat of fusion, and obviously the original differential equation will have very little bearing on the result. Dr. Jeffreys, in his second edition of "The Earth", has simply solved this problem by assuming that if at any depth the radioactive materials were sufficient to raise the medium above the melting point, then the resulting convection currents would exactly carry off the excess heat and a steady state would again be attained. Mathematically, this is equivalent to assuming that the effective conductivity of the medium would adjust itself to give the required heat flow at the required temperature gradient. It is not often that Nature is so accommodating.

It is possible, nevertheless, to discuss the problem mathematically rather more fully, and I have attempted to do so in a paper on "The Thermal Instability of the Earth's Crust" published in the *Scientific Proceedings* of the Royal Dublin Society, vol. 19, No. 32. In this paper, it is shown that, assuming a basaltic crust with a definite melting point and latent heat, and a melting point pressure curve steeper than the adiabatic for the liquid state, conditions which ordinary basalt apparently fulfils, then periodic partial melting and resolidification of the crust, if it exceeds a certain depth, appear to be physically inevitable, quite apart from any tidal or other effects. This result certainly must be applied with caution if the crustal materials have no definite melting point. Personally, I consider that if these materials are capable of existing over a certain range of temperature and pressure as two phases which differ greatly in viscosity and total energy content, then it is probable we are justified in doing so. If, on the other hand, they pass slowly from the liquid to the solid or highly viscous glassy state, so that their viscosity and energy content at a given temperature and pressure are always single valued, then probably Dr. Jeffreys' assumption would be correct. Enough, however, has been said to show that Joly's original theory of thermal cycles cannot be dismissed as in any way physically impossible or improbable. The whole question ultimately hangs on the real properties of the substratum.

Turning to a second point in Prof. Holmes's review, he objects to Joly's theory on the ground that it leads to an alternation from world-wide tension to world compression, which he says he finds geologically unacceptable. To get over this difficulty he has proposed a system of large-scale convection currents in the substratum in which the stresses in the surface crust are due entirely to this current motion. In this, he neglects the fact that if thermal energy is accumulating at any time in the subcrustal materials, they must tend to expand, due either to ordinary thermal expansion or to increase of volume on fusion, and that therefore such epochs must on the whole result in increased tension in the outer crust. The only escape I can see from this impasse is to assume that the progress of energy accumulation and discharge is not simultaneous over the whole earth. It would appear easier to do this on Joly's hypothesis than on Holmes's modification of the theory. Besides, it is not at all certain that there is no evidence for world-wide tension and compression. It is usually held that mountain-building epochs, that is, states of compressional strain, are more or less world-wide and contemporaneous, and if the evidence for world-wide tension is not so obvious, this may be due to the fact that it has largely been taken up in the ocean floor, where its effects would not be so open to our inspection, as Joly has already pointed out. It is perhaps also not without significance that the so-called common fault in geological science is a tension fault.

To refer to another matter: the connexion which Holmes has emphasised between the state of the outer shell of the earth and terrestrial magnetism appears to be most important. On Larmor's convection current theory of the origin of the earth's magnetic field, we might expect the strength of the field to increase largely in times of revolution when the subcrustal materials are most fluid. Mercanton, of Switzerland, has already attempted to determine the direction of the field at various geological epochs by investigating the direction of magnetisation of lava flows of different ages, and it is just possible that by measuring their intensity of magnetisation some information as to the strength of the earth's field at the time of solidification might be obtained. The problem is not a simple one, since the intensity of magnetisation would depend, not only on the field strength, but also on the chemical composition of the various lavas, and possibly other variables. It indicates, nevertheless, a new avenue of approach to the problem, which might yield some interesting results.

J. H. J. POOLE.

Trinity College, Dublin,
Feb. 24.

WHEN I wrote my review of the second edition of Prof. Joly's book several months ago, I had not seen Dr. Poole's paper, but the ideas which he there treats mathematically were by no means new to me, for I had already envisaged them in a qualitative way in my paper "Contributions to the Theory of Magmatic Cycles" (*Geol. Mag.*, 1926, p. 315 *et seq.*). So far from denying that they have important applications, I have since attempted to develop the principles involved, especially in their relation to problems of petrogenesis. In stating that "Joly's mechanism of alternating accumulation and discharge of heat seems to be physically unacceptable", I had particularly in mind the probable distribution of radioactivity through the whole of the earth's substratum, that is, down to a depth of 2900 km.

Joly and Poole appear to assume the existence of a thick layer of material of basaltic composition through which successive waves of fusion develop, pass upward, and die out, this layer being underlain by a lower layer of crystalline rock. The latter conception has hitherto been tacit, but Poole has given it definite expression in the paper to which he refers. On p. 405 he speaks of "a lower infusible layer, such as probably occurs in the earth's crust". In the light of all the relevant evidence, I can see no reason

for making such an assumption. Its adoption implies the belief that the material below the 'basaltic' layer is practically free from the radioactive elements. The data and principles of geochemistry (involving in particular the known partition of the radioactive elements between basaltic rocks and peridotites, and between stony and iron meteorites) seem to me to make it incredible that the radioactivity of the deep substratum can be ignored. Kimberlite, which cannot be a differentiation product from basaltic magma and presumably comes from a deeper level of the substratum, as convincingly argued by Wagner, provides the only direct evidence yet available, and it confirms the deduction that the substratum is far from being devoid of the radioactive elements. But this being so, the substratum cannot yet have cooled to a crystalline solid; it must still be an extremely rigid and viscous glass discharging heat with the aid of convective circulation. On this view, the earth has not yet reached the stage of its thermal history when the conditions visualised by Joly—or the still later conditions of contraction adopted by Jeffreys—could begin to control geological events.

Dr. Poole's second point is fully referred to in my recent paper on "Radioactivity and Earth Movements" (*Trans. Geol. Soc. Glasgow*, vol. 18 for 1928–1929, pp. 559-606; 1931). The view is there developed that tension arises where ascending convection currents approach the under surface of the crystalline crust and turn along in opposed directions, and that compression arises where the lateral currents of adjacent circulation systems approach and turn downwards. One effect of this compression is the local transformation of the material of the 'basaltic' layer into eclogite, a metamorphic change involving marked decrease of volume and consequent sinking of the denser material. The convection theory requires simultaneous compression and tension in different regions of the globe. It certainly does not imply systematic world-wide expansion of the substratum or tension of the crust. The internal excess of heat is discharged partly by the slow growth of new geosynclinal or ocean floors over the sites of rising currents; partly by the heating up and fusion of sinking eclogite blocks in descending currents; and partly by igneous activity of the familiar kind, the latter representing effects at and near the surface which are thought to be brought about largely by processes such as those discussed by Dr. Poole in his papers on "The Thermal Instability of the Earth's Crust".

Arthur Holmes.

The University, Durham,
Mar. 5.

Novelty throughout Nature.

If I characterise a kind of evolution as advance through new products towards further novelty, there are many who will roundly deny that there is evidence of anything of the sort. Hence a live issue.

(1) Let us first in some way define novelty. In a preliminary way one may say that what is new could not be predicted before the event of its first occurrence. Here the stress is on 'before the event'. After the event, the recurrence of like events in like circumstances may be predictable.

A distinction is sometimes drawn between 'real' and 'apparent' novelty, and then it is said: Given adequately comprehensive knowledge of Nature, all that is apparently new could have been foretold and is therefore not really new. Such a distinction confuses the issue. This or that either *is* new and unpredictable before the event of its first occurrence *or*, as predictable on the basis of knowledge up-to-date, it is *not* new.

We have then to correlate 'up-to-date' with 'before the event'. One has reference to knowledge; the other to the course of Nature as thus far known. Here the emphasis falls on 'thus far'. The evolution of knowledge may itself be an advance through new products towards further novelty.

(2) Let us now ask: What is it that is new? If one may liken that which goes on in an atom, a molecule, a crystal, a living organism, a mind, to a 'game' that is played in the field of Nature, one may submit that in each case the relational conditions under which it is played are new; that the rules of the game are new; that the characterising features (qualities and properties) of the players are new.

(3) In any practical inquiry on the part of a specialist in some branch of science, he commonly starts with a state of affairs which is (let me say) 'prescribed', in the sense that this is just the kind of game that he finds already in progress with repeated routine of procedure as heretofore. But what is thus prescribed may be the 'recurrence' of that which at some earlier stage of evolutionary advance was new, in so far as the relational conditions of its first 'occurrence' were unprecedented.

In further detail, the procedure of the man of science may be on this wise. In some advancing process, he selects three stages, spaced at discretion, with or without intervening stages; and he commonly narrows them down, here, there, or elsewhere, so as to get them as close-set as possible. He then concentrates attention on the mid-stage. He may deal, for example, with vapour and liquid, liquid and solid; with atom and molecule, molecule and crystal; with matter and life, life and mind. In each case he seeks to fill in the 'and' which stands for 'passage to'.

Take the first case of vapour, liquid, solid. Having at hand many samples of all three, he learns all that he can of the passage of one to the other under differing conditions. But this, though it may suggest, does not bring him face to face with the question of novelty from the evolutionary point of view. That question may be thus stated: If the cosmic order of advance has been from vapour through liquid to solid, could anyone have predicted liquid (not yet in being) from the platform of vapour in some hot star? Or solid from the platform of liquid on a cooling planet? Or are there new rules of each game which could not be predicted before it was in play?

Similar in principle are, among many others, the questions: From the atomic platform could the molecule and the crystal be predicted? From the platform of lifeless matter could life and mind be predicted?

In *all* cases the answer may be, Yes. Then the whole course of evolution is devoid of a single example of novelty. If in *some* cases the answer is No, we must in some way characterise that kind of evolution in which they obtain and formulate generalisations as to how, when, and where some new game supervenes on those already in play.

(4) It may here be said that prediction implies a basis of knowledge, and that on the platform of lifeless matter there was as yet no knowledge. Can we escape the predicament in which we are thus placed? Some logicians reply that we can.

No doubt, we cannot discuss natural advance save in terms of our knowledge thereof. But we can ask whether, given all those generalisations which have reference to the atomic game (let us say), one is in a position to deduce therefrom all the generalisations

which have reference to the molecular game. And so on with regard to other games.

Apart, then, from an evolutionary order of advance, we now ask: Are all games *now in play* such as to enable the skilled logician to deduce from any one of them the rules of all others and the characterising features of the players? If so, no one of them affords an example of novelty.

Hence it seems that our cardinal issue largely hinges on a logical issue to be decided by those who know not only the rules of this or that Nature-game but also the rules of the game of logical deduction. If there is divergence of expert opinion, those who are interested amateurs in logic must leave the decision *sub judice*. That still leaves it open to them to believe that there is novelty throughout Nature.

(5) Meanwhile, men of science pursue their inquiries and formulate generalisations founded on observation and experiment. Let each speak as he finds and thus bring fresh data as grist to the logical mill. In the field of animal behaviour, I find much that I can predict fairly confidently if I know the precedent life-history of the individual. That which I can thus predict is the recurrence of such and such a manner of behaving in these circumstances or those.

None the less, at all levels of behaviour, I find well-organised examples of novelty which I did not foresee. In each individual, high or low—but more conspicuously in those of higher status—I find subtle nuances of variation from the stereotyped routine of recurrence. The more closely I observe the behaviour of this or that animal, however lowly in estate, the more am I impressed with some tincture of that kind of unpredictable variation which affords an example of novelty at its birth. Such unforeseen departures from routine seem to exemplify new products, and they may be stepping-stones on a line of evolutionary advance towards further novelty.

If this be so, it is novelty that *leads* in the forefront of such advance. But it leaves in its wake a trail of prescribed routine. We thus pass from novelty in precedent behaviour to relative fixity in consequent routine, subject to the proviso that were there no novelty there would be nothing to fix. We pass to certain rules (of 'conditioning', 'inheritance', and others) which are distinctive of the life-game as such; rules which are learnt only through prolonged observation and experiment. Into these I need not enter, since novelty is my theme.

(6) My plea is for the recognition of novelty throughout Nature. My thesis is that novelty is no less natural than is prescribed routine. If we start with established order in routine, the introduction of novelty may be said to call for some 'alien influx into Nature'. The question then arises: Whence comes this novelty? The reply of those who keep within the limits they assign to scientific inquiry may be: It is no part of *our* business to say whence comes Nature or aught within Nature. We leave that to others. If we find novelty therein, we are content to accept what we find as we progressively build on the foundations laid by observation and experiment.

If, however, novelty in some way leads to routine, we must budget for some such generalisation as this: When in the course of advance there supervene new relational conditions and new products with new characterising features, the recurrence of these conditions always entails the recurrence of those characterising features.

Herein there is nothing which contravenes a deep-seated belief in the recurrent uniformity of Nature.

C. LLOYD MORGAN.

St. Leonards-on-Sea,
Mar. 2.

Change of Susceptibility of Paramagnetic Salts under the Influence of Light.

ACCORDING to Bohr's theory of atomic structure, the colour shown by compounds of elements belonging to the transition groups is ascribed to the presence of incomplete inner shells in them, and to the small difference in the binding energy of an electron attached to the outer valency and the inner incomplete shell respectively. Since the transference of an electron from the inner to the outer shell involves a change in its orbital moment, it is therefore to be expected that under the influence of light absorption the magnetic moment of the absorbing ion would also alter. One of us tried to observe this effect several years ago without any success, due, as it appears now, to the arrangement used not being sensitive enough.

According to Bohr's theory, the magnetic moment of an atom or an ion can only be due to the presence of uncompensated orbital moments of its bound electrons. The hypothesis of the existence of spin moments in electrons introduced by Uhlenbeck and Goudsmit has considerably increased our understanding of intra-atomic phenomena. Attention has recently been directed by Saha (NATURE, **125**, p. 163, Feb. 1, 1930) to the part played by the spin moment of electrons in producing absorption in the visible region in certain paramagnetic salts.

Saha advances the view that in a salt, like chromic chloride, the absorption in the visible region is entirely due to the outer electrons of the Cr^{+++} ion. The most stable states of the Cr^{+++} ion are ^4F and ^4P, and the next higher ones are ^2H, ^2G, and ^2D. The transitions from one to the other are brought about by the reversal of the spin axes of one of the d electrons of the Cr^{+++} ion. The average difference in energy between the two sets of terms is about 20,000 cm.$^{-1}$ ($d = 4916$ mμ), which is near the absorption region of Cr^{+++}. From this, Saha concludes that the absorption of light in the visible region is due to some of the 'd' electrons changing their 'r' vector from $+\frac{1}{2}$ to $-\frac{1}{2}$.

About the same time S. Kato has, in a series of papers "On the Absorption Spectra of Salt Solutions" (*Sc. Rep. Inst. Phy. Chem. Res.*, Japan, vol. 12, p. 230, vol. 13, pp. 7, 49; 1930), shown that in the case of certain paramagnetic ions of vanadium, chromium, molybdenum, etc., in solution, their absorption spectra contain, besides regions of continuous absorption, also certain regions of selective absorption; for example, in the case of the violet solution of chromium chloride in water, she finds two selective absorption regions with wave-lengths 4150 (24,100 cm.$^{-1}$) and 5500 (18,200 cm.$^{-1}$). These absorption frequencies are, according to her, in fair agreement with those emitted during the following transitions of the Cr^{+++} ion. $^4F' - {}^2H' = 20{,}718$ cm.$^{-1}$ and $^4F' - {}^2G' = 14{,}758$ cm.$^{-1}$, when the influence of the surrounding water molecules, etc., is taken into consideration. The difference between the two observed absorption frequencies is 5900 cm.$^{-1}$ and is in good agreement with the mean difference $^2G - {}^2H' = 5960$ cm.$^{-1}$.

As the transition of an ion like Cr^{+++} from its most stable state to the next higher one represents a reduction of its spin moment, then on the view that the magnetic moment of these ions depends mainly on their resultant spin moments (Bose, *Zeit. f. Phys.*, **43**, 864; 1927), such transitions will always be accompanied by a reduction of their corresponding magnetic moments and therefore of the susceptibility of the salts containing them. For some time past we have been engaged in investigating this subject and have obtained definite evidence of the lowering of the paramagnetic susceptibilities of solutions of compounds of iron, nickel, cobalt, chromium, and copper.

For example, we took a solution of chromic chloride (green), which according to S. Kato has the following absorption regions: 4300 mμ and 6100 mμ. Light from a mercury vapour lamp was passed through suitable filters to cut off entirely the infra-red radiation and to transmit either 4358 mμ or 5460 mμ and 5790 mμ only, and allowed to fall on a bulb containing chromic chloride (green) solution. In the latter case, preliminary observation showed that the line 5460 is very little absorbed by the green chromic chloride solution. In both the experiments, a definite lowering of the susceptibility was observed, as indicated by the deflection, in an inhomogeneous magnetic field with a steep gradient, of the small bulb containing the solution, which was suspended from a torsion arm. Solutions of nickel and ferric chlorides, copper sulphate, etc., show selective absorption in the near infra-red, and the decrease of their susceptibilities due to such absorption have also been observed. These investigations, which have so far yielded only qualitative results, are being continued.

D. M. BOSE.
P. K. RAHA.

Dept. of Physics,
University College of Science,
92 Upper Circular Rd., Calcutta,
Feb. 12.

Negative Attenuation of Wireless Waves at Broadcast Frequencies.

ATTENTION has been directed from time to time to negative attenuation observed on wireless waves propagating over land. Ratcliffe and Barnett have noticed increase of field intensity with distance in their observations on Daventry (1600 metres).[1] Recently Barfield and Munro also noticed that the field strength of 2LO at a distance of 10 km. was slightly greater than the figures calculated according to the well-known propagation equations.[2] These

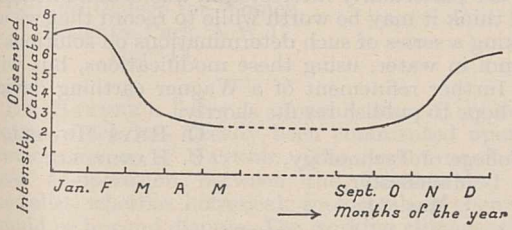

FIG. 1.—Ratios of observed to calculated values of field intensities of the Bombay Broadcasting Station for weekly averages of observed intensities. The broken line represents monsoon period, when observation was impossible, due to thundery weather.

observations refer to long waves of the order of 1600 metres or to short distance field strength experiments, at positions so close as 10 km. from the transmitter.

The present note deals with a type of negative attenuation effect observed on a 357·1 metre wave at a great circle distance of about 640 km. Field intensities of the Bombay Broadcasting Station were measured in the laboratories and gave an average ratio of more than 2·5:1 between the observed and calculated values. The ratio sometimes reached an abnormal figure of 7:1 in the early part of the year, dwindling down to about 2:1 about the middle of the year (Fig. 1). These consistent abnormally high signal strengths are believed to be a clear case of negative attenuation at great distance from broadcasting stations.

Three features of this service may be mentioned:

(*a*) Excessive fading with periods of very strong signals.

(*b*) General poor audibility with daytime transmission.

(*c*) Abnormally strong signals during wintry months as compared with summer-time reception.

It is suggested that the major part of reception is due entirely to the indirect or the sky ray, the ground wave being almost wholly absorbed. The topography of the country intervening between the transmitter and the receiver lends support to this view. The former is situated at sea-level at the base of a long mountain range, away from the receiver, which is itself about 3000 feet above sea-level. The mountain range is about 10,000 ft. high and covered with dense tropical forest regions. This would, no doubt, exercise considerable shielding and absorption effect on the ground ray.

The propagation equations having failed to explain these abnormal results, attempts were made to apply Sommerfeld's theory of wave propagation on land, taking account of dielectric constant and ground conductivities. The modified equations as obtained by Rolf[3] were used. The ground constants and calculated attenuation factors are tabulated below:

Authority.	λ.	Conductivity.	Dielectric Constant.	Attenuation Factor.
Barfield .	365	$6{\cdot}4 \times 10^{-14}$	10	0·18
Ratcliffe and Barnett .	360	$11{\cdot}7 \times 10^{-14}$	10	0·025

From these factors, the observed value of intensities would appear to be 14 and 100 times the expected figures. Apparently the ground ray is very feeble and the sky ray gives a strong signal of variable intensity. It is significant to compare these ratios with the ratio of the observed indirect and direct ray intensities. According to Eckersley[4] this ratio is 10 for a wave-length of 375 metres and at a distance of 600 km. from the transmitter.

It is concluded that the negative attenuation effect referred to above is explained by the probability that the observed field strength is due entirely to the indirect ray, all propagation equations applicable to ground-level transmissions giving signal intensities which are too low.

S. R. KANTEBET.
Communication Engineering Laboratories,
Indian Institute of Science,
Bangalore, India, Jan. 28.

[1] *Proc. Camb. Phil. Soc.*, vol. 23, p. 300.
[2] *Jour. I.E.E.*, vol. 67, p. 254.
[3] *Proc. Inst. Radio Engineers*, vol. 18, No. 3.
[4] "Service Area of Broadcasting Stations", British Broadcasting Corporation's Private Publication.

Variable High Resistance Grid Leaks.

THE difficulty of obtaining very high resistances for certain forms of experiment can be overcome by the use of suitable photoelectric cells, as has been suggested by Messrs Adam Hilger, Ltd. Not only have these the necessary resistance, but also they can be made to act with controlled variability as variable grid leaks. This result we have obtained by mounting the photoelectric cell and grid connexions of a capless valve on amber and vitreosil, the valve itself being suspended in a ring of vitreosil. The cathode of the photoelectric cell is attached to the grid, and the anode to whichever side of the filament is found most suitable. The cell is completely darkened except at one point where it is exposed to a small lamp lit from batteries controlled by a

continuously variable rheostat. The lamp connexions, batteries, and rheostat are contained in a screened tube and box, with the screen earthed to avoid variations due to the adjustment and handling of the rheostat.

A large range of high resistance variation can be obtained by choice of the material of the cell and cathode, by the nature of gas used, or by degree of vacuum. No battery is required, the difference of potential across the cell being merely the difference of potential between the grid and the filament leg to which attachment is made. The apparatus in which use is being made of this variable high resistance is a modification of that described in the *British Journal of Radiology*, March 1930, for detection of the variable electric field of the human body.

W. E. BOYD.

Glasgow, Feb. 25.

The Velocity of Light.

IN NATURE of Oct. 22, 1927, p. 602, I summarised the observational evidence respecting the velocity of light. In *Astronomische Nachrichten*, No. 5530, I pointed out that this evidence is in favour of a decrease of this velocity, which is assumed to be constant owing to considerations of a theoretical order only.

I have just heard of a determination of this 'constant' made by Karolus and Mittelstaedt (*Phys. Zeits.*, vol. 29, pp. 698-702; 1928) in July 1928, that is, since the last determination (299,796 ± 4 km./sec.) made by Michelson at the beginning of 1926. The average of 755 measures gave 299,778 ± 20 km./sec. It is remarkable that this is 18 km./sec. *less* than the value obtained by Michelson, and falls in good alignment with the last three determinations made in the present century:

1902.4	Perrotin	299,901 ± 84 km./sec.
1924.6	Michelson	299,802 ± 30 ,,
1926.0	,,	299,796 ± 4 ,,
1928.5	Karolus and Mittelstaedt	299,778 ± 20 ,,

If the velocity of light is constant, how is it that, *invariably*, new determinations give values which are lower than the last one obtained, the observations distributing themselves so as to put in evidence an excellent linear law of variation, as can be ascertained by plotting the above results. The graph does not show the slightest sign of a tendency to approach asymptotically a horizontal line. It is frankly oblique to the axis of time. There are twenty-two coincidences in favour of a decrease of the velocity of light, while there is not a single one against it.

The velocity of light is affected by magnetism, and the measurements of this 'constant' are performed in a magnetic field of varying intensity, namely, the earth's magnetic field, yet no correction seems to be applied to allow for this variation in the physical conditions in which the experiments are carried out, or in any other which may be present.

Vrkljan has shown (*Zeits. für Phys.*, vol. 63, pp. 688-691; 1930) that a decrease in the velocity of light is not in contradiction with the general theory of relativity. Certainly it is time that the constancy of this velocity should be established beyond doubt on experimental evidence, instead of merely postulated theoretically.

The relatively large error of this new determination prevents it from deciding the question. A redetermination of the 'constant' by Michelson would settle it once for all.

M. E. J. GHEURY DE BRAY.

40 Westmount Road, Eltham Park,
London, S.E.,
Mar. 8.

Hydrolysis of Acetone in Ultra-Violet Light.

IN the course of our investigations on the hydrolysis of acetone in ultra-violet light, we have measured the effect of the variation of light intensity on this reaction and found a direct proportionality between incident light intensity and reaction velocity. Two sets of experiments were carried out, in one of which the intensity was varied by means of a rotating sector and in the other by using diaphragms of different apertures. The results, in both cases, give a fairly constant value of the ratio, change/intensity. The detailed results of these experiments and their discussion will be published shortly elsewhere.

We have further observed that when aqueous solutions of acetone are exposed in closed plane-walled quartz vessels to the full light of a quartz mercury lamp, as well as acetic acid, formaldehyde is formed in quantities sufficient to be detected and estimated colorimetrically. Bowen and Watts [1] could not detect any other product except acetic acid under similar conditions. In our opinion, the low quantum efficiency (0·2) found by these investigators for this reaction may be partly due to the formation of formaldehyde. Experiments to confirm this idea and re-determine the quantum efficiency are proceeding and will be reported in due course.

M. QURESHI.
N. A. TAHER.

Department of Chemistry,
Osmania University College,
Hyderabad-Deccan, Jan. 22.

[1] *Jour. Chem. Soc.*, **129**, 1611; 1926.

Measurement of the Electrical Conductivity of Electrolytes.

IN NATURE of Mar. 21, p. 441, M. Lecomte du Noüy outlines improvements in the method commonly used to measure the electrical conductivity of electrolytes. We are particularly interested in this communication, and think it may be worth while to record that we are making a series of such determinations on solutions of phenol in water, using these modifications, but with the further refinement of a Wagner earthing device. We hope to publish results shortly.

O. RHYS HOWELL.
C. HANDFORD.

College of Technology,
Manchester,
Mar. 24.

Red Snow in Persia.

ON several occasions I have observed 'red snow' on the mountains in Bakhtiari country, south-west Persia. It usually occurs in patches a couple of yards wide and a score of yards long, lying with normal white snow. To-day (Feb. 14), however, the phenomenon occurred on an entirely different scale, a whole mountain-side being covered with 'red snow'. Two days ago, a heavy fall of snow occurred, lying down to about 6000 ft. above the sea-level. Yesterday was mild and misty, while to-day was misty in the morning but clear in the afternoon. The mist cleared away from above downwards and had dispersed above 5500 ft. above sea-level by 10 A.M. There were a few cloud pennants to be seen infrequently tailing from the higher peaks.

Kuh-i-Javanbin (10,000 ft.) and Kuh-i-Shirgun (9500 ft.) are the two mountains on which the 'red snow' was seen. Both are smooth-topped ridges running north-west and south-east. The south-west flank of each is a dip-slope of Cretaceous limestone now snow-clad. An irregularity at the south-east end of Shirgun has produced an extensive facet facing directly

south. Viewed at 10 A.M., this facet, of the order of 1000 ft. high and 2500 ft. broad at its base, and situated above the 8000 contour, appeared to be coloured light orange-pink and contrasted strongly with the pure white of the snow on the rest of the south-west flank of Shirgun and Javanbin. By 3 P.M. the pink colour had spread all along the south-west slope of Shirgun, a matter of 4 miles, and Javanbin was coloured on its lower slopes although the top 1000 ft. remained white. By this time the original south-facing facet of Shirgun was mottled pink and white.

The phenomenon of 'red snow' is well known to the tribesmen, who associate the colour with rapid thawing of the snow in the early spring.

J. V. HARRISON.

Chulbar, Feb. 14.

Forestry Research.

THE articles in NATURE of Feb. 21 and 28, reviewing the work of the Forestry Commission, prompt me to express the wish that they may be perhaps followed by one dealing with certain aspects of forestry research, more especially with recent work bearing on the importance of biological soil factors in relation to tree growth.

For example, the significance of mycorrhiza in nutrition, and the urgent need for laboratory research directed to promote control of its formation in new plantations, have long been matters of concern in the Swedish Forestry Service and are becoming so in those of other countries, that is, in certain of the North American States. In Sweden, a close working alliance between forestry expert and botanical specialist has already produced significant results.

In Great Britain and many parts of the Empire the matter is one of special interest and concern in view of the extensive afforestation of non-woodland soils and the use of exotic tree species.

M. C. RAYNER.

Bedford College for Women,
Regent's Park, N.W.1,
Mar. 13.

DR. RAYNER'S letter is of value since it voices a matter which has already been commented upon in previous issues of NATURE. The urgent need of a close co-operation between the forester and the specialist, whether botanical, zoological, or chemical, should be beyond dispute. The working alliance which has come into being in Sweden—foresters, timber companies, and scientific research centres—will well repay study, as also the amalgamation of various interested bodies in New Zealand. The great Forest Research Institute at Dehra Dun furnishes a further illustration. Whilst, however, these examples merit the closest study, a slavish imitation of any one by Great Britain may result in wasteful expenditure, and also lead to much overlapping of investigation and research work. There are instances where the creation of Government research laboratories paid for out of public funds are justified, if not indispensable for the time being. In other cases this is not so. Research work can be safely left, and with the certainty of better results, to already existing centres, grants being made by the Government department concerned to cover the cost of certain pieces of investigation work required to be undertaken.

It is hoped to consider this question in fuller detail in a subsequent number of NATURE. Meanwhile Dr. Rayner's recent paper, "Mycorrhiza in Relation to Tree Growth" (published in the *Empire Forestry Journal*, vol. 9, No. 2, 1930), furnishes an illustration in point.

EDITOR OF *NATURE*.

β-Transformation.

THE theory of radioactive transformation on the basis of wave-mechanics was initiated by Gamow and Condon and Gurney. The consequences have been worked out in detail by Born [1] and Kudar.[2] But Heisenberg's objection to the construction of particles out of packets of Schrödinger waves, that they tend to spread out in course of time, has not yet been met.

It would be interesting to consider the chances of α and β particles being emitted from the nucleus as such. Restricting ourselves here to β-radiation and taking into account the relativity variation of mass, it is easily verified that the acceleration (or deceleration) of a fast electron due to the same force is $(1 - v^2/c^2)^{3/2}$ of its Newtonian value. The electron can, therefore, overcome a higher obstacle under relativity mechanics than under the Newtonian.

If E is the total energy of particles inside the nucleus, E' is the minimum energy which enables an electron to jump over the potential barrier, N' is the number of particles inside the nucleus possessing the energy E or more, and N the total number, we see that the radioactive properties would depend upon the number N'. Using Fermi-Dirac statistics, we find

$\frac{dN}{dT}$ always positive and

$$\frac{dN'}{dT} = \text{const.} \left\{ \frac{E'T}{e^{\alpha + E'/kT} + 1} + \frac{E'}{T} - \frac{\partial E'}{\partial T} + \frac{3}{2} \int_{E'}^{\infty} \frac{E^{1/2} dE}{e^{\alpha + E/kT} + 1} \right\}.$$

Thus N always increases with T (the temperature inside the nucleus), and, subject to a certain restriction radioactive properties are a direct consequence of increasing atomic numbers. More definite conclusions depend on precise knowledge, which is at present lacking, of the potential barrier.

B. M. SEN.

Rajshahi College, Bengal,
Feb. 10.

[1] *Zeit. f. Phys.*, Bd. 58, 306; 1929.
[2] *Zeit. f. Phys.*, Bd. 53, 61, 95, 166; 1929: Bd. 54, 297; 1929.

The Swimming of Cuttlefish.

IN NATURE of June 14, 1930, p. 893, F. S. Russell and G. A. Steven publish some observations on the movements of *Sepia officinalis*, special attention being given to the part played by the siphon. These researches are a confirmation of what was seen by me so long ago as 1912 (*Internationale Monatsschrift für Anatomie und Physiologie*, Bd. 39; 1912) and clearly explained in Figs. 33 and 34 of my paper (p. 129).

OSVALDO POLIMANTI.

Istituto di Fisiologia,
R. Università di Perugia.

WE are indebted to Prof. Polimanti for directing our attention to his previously published observations on the swimming of cuttlefish. We have not access to the journal in which his work was published, so, unfortunately, have not at the time of writing been able to read it. We felt that so obvious a feature in the swimming of the cuttlefish must have been seen before; being unable to find any reference to it, we published an account in the hopes that the information might eventually find its way into English text-books, in which the use of the siphon in cuttlefish swimming is given as only for backward darting.

F. S. RUSSELL.
G. A. STEVEN.

Forests, Climate, Erosion, and Inundations.

FOR centuries a popular belief has existed that forests induce or attract rain. With the progress made in the conservation of the forest on carefully prescribed plans of management, the forester took a hand in the controversy which, with the diminution of the area of forest in the more populous parts of Europe, gradually arose round this matter. A considerable literature is devoted to the problem of the influence of forests on rainfall and other forms of atmospheric precipitation. Until recently the opinions held and the arguments advanced for and against the effects of the forest on climate have been more or less one-sided and based to a great extent on generalisations.

During the last few years this important matter has entered on a new and most promising stage in its history. On the subject of the general question of forests and rainfall, etc., two papers representing the opposite opinions held in this matter have been published; the one, "Forests and Water in the Light of Scientific Investigation", by R. Zon, of the U.S. Department of Agriculture (1927), and the other, "The Influence of Forests on Rainfall and Run-off", read by Dr. C. E. P. Brooks before the Royal Meteorological Society (1927). Since these two papers, several other important contributions to this subject have appeared. In 1929 Mr. B. O. Coventry published a paper on "Denudation of the Punjab Hills" which was reviewed in NATURE of Feb. 1, 1930. In the same year a Kenya Forest Department pamphlet appeared entitled "The Influence of Forests on Climate and Water Supply in Kenya", by J. W. Nicholson (of the Indian Forest Service, now Forest Adviser to the Governments of Kenya and Uganda) and A. Walter, Director, British East African Meteorological Service.

Previously to Mr. Coventry's report, Mr. L. B. Holland, of the Indian Forest Service, had been specially deputed by his Government to make a tour of inspection in the outer hills of the Punjab in 1927 and 1928, his report on the matter ("A Report on Denudation and Erosion in the Low Hills of the Punjab") being published in 1928. At the Punjab Engineering Congress, 1930, held in Lahore, a paper entitled "Erosion in the Punjab Himalaya and its Probable Effect on Water Supplies" was submitted to the Congress by Messrs. L. B. Holland and H. M. Glover, the latter also of the Indian Forest Service. The two latter examples from Kenya and the Punjab are of high interest; since in one case we have at length the necessary association and collaboration of the forestry expert with the meteorologist, whilst in the other an equally important association, where great irrigation works depend entirely upon the permanence of the water supplies, of the forest and irrigation officers.

Finally, in *Matériaux pour l'étude des calamités* (No. 23, No. 3; 1930), issued by the Société de Géographie de Genève under the auspices of the Committee of the International Red Cross and the League of Red Cross Societies, a paper appears, "Les Forêts et les inondations", by MM. Delville et J. Delévoie. At first sight it appeared a matter for surprise to find forestry matters being taken up by the Red Cross. But the reason soon became obvious. It was one of the most serious effects of erosion, inundations and their often appalling catastrophic effects on the populations in the lower hills and plains, which proved the point of interest to the Red Cross Societies.

It may be maintained without fear of contradiction, by those possessing any knowledge of this complicated question of forests, climate, erosion, and inundation, all of which are covered in the papers above mentioned, that the latter in their several ways have made a valuable contribution to our knowledge. They mark a distinct step forward in the direction of possible practical results in coping with the several evils resulting from man's ignorant action upsetting Nature's balance between the forests, water supplies, and unforested lands. In the present article, more than a brief analysis of these papers is impossible: their close study will well repay those interested in these questions; as also those responsible, from the positions they hold, for checking further destruction and undertaking remedial measures to minimise the harm already resulting from ignorance or vandalism.

The present position of the controversy on forests and rainfall is well summed up in the Kenya pamphlet by Nicholson and Walter. R. Zon, the American authority, holds to the belief that forests induce rain, and that the most important influence of forests is their capacity for regulating the flow of surface water, and consequently the streams issuing below them. Zon has collected and puts forward to support his views a large number of data and observations, the value of which is fully recognised by the Kenya authors, although they believe that, as also in the case of Dr. Brooks, data contradictory to the theories of these two are ignored, whilst unsupported generalisations put forward will not bear scientific analysis. Brooks holds the point of view opposite to that of Zon, and his treatment of the matter is on the more scientific plane, though generalisations also appear.

As most forest officers who have given thought to and had any practical experience of the problems involved are aware, it is due to the fact that so much theory has been indulged in and so much written that would not bear either scientific analysis or (as, if not more, important) such practical field tests as were feasible, that has led to this question being neglected in the past—in fact, it might even be added, to the question being treated with derision by a certain type of forest officer, by the public, and by the civil authorities. The last were only too ready to close their eyes to the damage being done, owing to the outcry which they knew would arise from the people engaged in destroying unchecked the forests which had for so long played their protective part in, as we are now learning, a very varying degree and manner.

It is unnecessary to consider here the elementary

ideas upon the direct and indirect benefits of forests from a climatic point of view in different regions of the world. Any text-book will afford a summary. Zon's and Brooks's publications must be consulted for their full views. The pamphlet by Nicholson and Walter is important, since it marks one of the first, it is believed, practical contributions to the possible effects of (*a*) destruction of forests, (*b*) afforestation of certain types of area on the climate, and especially rainfall, in Kenya and Uganda. Even if put forward tentatively, they are practical suggestions. For example, one of the conclusions arrived at is " that under favourable circumstances mountain forests in East Africa can induce occult precipitation (fog or dew) up to at least 25 per cent of the total annual rainfall ". Perhaps the most interesting conclusion of these authors is, however, on the subject of ' instability rain ', to which they correctly assign the importance of a chapter to itself. Instability rain is a matter of supreme importance in some parts of the tropics. Dr. Brooks describes it as due " to the warming up of the surface layer of air to a point at which it is potentially higher than the air above it. The potentially light air begins to rise, at first in thin threads which produce scattered cumulus clouds, and finally, if the process continues far enough, in thicker columns which cause cumulo-nimbus clouds with rain and perhaps thunder and hail. The potential density of the air depends mainly on its temperature and partly also on its humidity." Nicholson adds a few further remarks to supplement this description. " In East Africa instability rain falls on still afternoons usually after bright sunny mornings. It is frequently accompanied by thunder and is always very local in its distribution. In some parts of Uganda to lessen the contingency of crops failing the natives cultivate two shambas some miles apart from one another. Unfortunately the European cannot copy this practice, but where the instability rain is the prevailing form of rainfall he can select a long-shaped in preference to a square-shaped farm."

Brooks minimises the possible effects of forests on instability rain. It may be accorded, however, to the Kenya authors, as a result of their investigations, that they have advanced good evidence for their present conclusion that " wherever meteorological conditions in East Africa are favourable to the production of instability rain the possibility and quantity of such rain is greatly increased by the presence of forests ".

Wind, and its connexion with a general consideration of this question, is dealt with in the Kenya pamphlet, but limits of space preclude further discussion of the interesting data.

Allusion has already been made to Mr. Coventry's paper on the denudation of the Punjab Hills. The report, written as the outcome of an examination made of the lower hills by Mr. L. B. Holland, furnishes evidence that the Punjab Government has at length become alive to the seriousness of the position which disafforestation, excess grazing, and so forth, has brought about over large areas of the lower hills. The best known example of the results following the unchecked removal of forest growth on a friable geological formation is the case of the Hoshiapur *chos*, which was being quoted so far back as 1877. Under a mistaken policy, the scrub forest on the hills was apportioned out amongst the villagers. With increasing population, increasing demands for fuel, and large calls upon the grazing (owing to the far larger herds now kept, due to the more settled conditions under British Government), the hills were entirely denuded ; enormous areas of valuable agricultural land were submerged by the tons of debris brought down through the rapid erosion of the now bare hills, and desolation supervened over part of the area known as the Garden of the Punjab. This is well-authenticated history. But much devastation of forest, with increasing erosion and denudation, has taken place since, and the position reached is now considered so serious that interference with the water supplies upon which the great Punjab irrigation schemes depend may be a not improbable future contingency. The paper by Holland and Glover read at the Punjab Engineering Congress (1930) is an effort to focus the attention of the engineer upon this matter, owing to the serious effect of further unchecked forest clearing in the hills on the water supplies. Afforestation is suggested, and the claims of building dams to arrest and catch the water pouring down bare hillsides during rain storms, as against the more natural and stable method of undertaking the same operation by means of afforestation, were discussed.

The last paper to which reference has been made is " Les Forêts et les inondations ", by MM. Delville et Delévoie. This paper is written in the interests of Belgium by the Director-General and an inspector of the Forest Service. Their analyses of the effects of forests on water-flow follow R. Zon to a great extent, with whose deductions they fully agree, although they recognise that contradictory opinions are held. They refer to the practical experiments on the subject of run-off from forested and bare areas which are being made in Switzerland and in the United States. Few dispute the argument that inundations have increased in late years in America, India, Africa, and even in Europe. In some cases this increase (18 per cent in the last twelve years in the United States) is directly attributable to disforestation. The control work which has been undertaken in Alpine countries in Europe is well known. The Japanese are engaged upon large afforestation schemes in Korea, mainly for climatic reasons. As a result of their survey of the position, undertaken owing to the serious inundations in Belgium of recent years, the writers of the paper under consideration lay down the following policy for the future : " On peut conclure avec la Commission du Conseil supérieur des Forêts, chargée d'une étude sur les inondations, qu'il y a lieu de lutter contre celles-ci :

" 1. Par une série de mesures destinées à conserver et à renforcer l'état boisé sur les collines et sur tous les plateaux élevés, dont beaucoup sont encore dénudés.

" 2. Par des travaux spéciaux de nature à ralentir la vitesse de l'eau sur tous les ruisseaux à pentes rapide, à allure torrentielle."

The Nature and Scope of Physical Science.

II.

By Prof. HERBERT DINGLE.

THE present position of physical science is that a large body of observations have been correlated by the two processes of abstraction and hypothesis. Abstraction has led us virtually to a contorted space-time, and hypothesis to a scheme of concepts unpicturable by the imagination. Both space-time and the scheme of concepts, however, by obeying prescribed rules, reproduce the data of observation, so that out of pure conceptions, having only a rational meaning, we can evolve, as it were, a very large part of the world of experience. This is the great achievement of modern physical science. The question that next arises is: What is the relation, in the category of reality, however we may define that word, of the world of experience to the connecting world of thought?

The question has been framed and answered by Sir Arthur Eddington and his answer is definite—the conceptual world is symbolic of the world of experience (" The Nature of the Physical World ", p. xv). But clearly that is not sufficient; otherwise science would be merely a form of art, and there would be no justification for laboriously expressing the obvious in terms of the incomprehensible when any poetaster could give an intelligible symbol of the world with infinitely greater facility. Apart from practical considerations, there are, so far as I can see, only two possibilities which can justify such a procedure: first, that the conceptual scheme is in some sense ' truer ' than the world of experience; second, that it reveals the existence of a connecting link between the diverse elements of experience. The fundamental characteristic of the views of science recently presented by Sir Arthur Eddington and Sir James Jeans is that the former alternative is adopted. I venture to suggest that this is a mistake: the conceptual world of physics is merely a means of making Nature intelligible to our minds and its laws are not to be interpreted as the truth about Nature.

It is impossible here to do more than indicate one argument supporting this statement. Since physical conceptions are always changing, any truth they represent must be exceedingly protean in form; on the other hand, the process of correlation of observations goes on continuously, and is, in fact, what directs the changes of conceptions. We cannot, therefore, regard the scheme of theoretical physics as telling us anything definitive about Nature, except that Nature appears to be intelligible.

An important example of the point at issue is found in the question of determinacy. It has recently been found advisable to suppose that there is a kind of indeterminacy in the behaviour of atoms, and this has been interpreted as a recognition of indeterminacy in Nature. Such an interpretation seems to subject us again to the error from which we have recently become emancipated. We have learned that abstractions (time, space, etc.) from phenomena are not to be foisted on atoms, and we immediately celebrate the discovery by foisting the characteristics of atoms on phenomena.

There is another example, however, which merits more detailed consideration, namely, the relation of science to measurement. Eddington (loc. cit., p. 275) and Jeans (" The Mysterious Universe ", pp. 140-141) identify the domain of science with the domain of the measurable, and their great authority has been widely invoked by non-scientific thinkers intent on ' putting science in its place '. It is usually a very simple matter to decide whether an experience is metrical or non-metrical in character, and a ready solution of many of the difficult questions raised by science is available if we can simply ignore everything that science has attempted to say of non-metrical experiences. Artists, theologians, metaphysicians, and moralists are thus enticed into what I believe to be a fool's paradise. Not only so, but this false escape from the challenge of science is necessarily accompanied by a real deprivation of its benefits. Art and religion have much to gain by a proper use of scientific principles, and the sharp restriction of the domain of science to the metrical elements of experience leaves them the poorer.

It is of course obvious that a large part of the data of science is non-metrical in character. The schoolboy's name for chemistry is ' stinks ', not ' balances ', and a very appropriate name it is. Biologists observe the flight of birds very closely, but they do not trouble to apply the Fitzgerald-Lorentz contraction, not because it is too small to be important but because it has no relation to the *kind* of observation they are interested in. It is clear, therefore, that much of the recording and augmentation of our experiences, which is essentially scientific, is not metrical. This in itself is sufficient to refute the doctrine in question: we need look no further in order to disillusion the non-scientific thinkers referred to above.

But this is not the whole of the matter. No doubt Jeans and Eddington would admit this readily enough, and still adhere to their opinions. For to them observations are just convenient tools for leading us to the truth underlying phenomena: it is that truth which they claim is metrical. Their doctrine applies not to the collecting of experiences but to their rational correlation, and they would say that when we come to analyse our experiences in order to discover the microscopic scheme of Nature, it is only the metrical elements that we can employ scientifically. I observe a cup, for example, and I notice that it is yellow in colour and hard to the touch. Those experiences I share with other normal people, and they are not primarily metrical. But when they are absorbed into the scientific scheme, it is only the metrical part of them which is used. The yellow colour, which I happen to dislike and of which someone else might be very fond, is represented only by a range of

'wave-lengths', about which neither of us has any emotions at all. The hardness is represented by 'electro-magnetic forces' (or modifications of 'space-time') which are definable by means of equations. Through these metrical quantities, all that is scientifically tractable in the yellowness and hardness of the cup is expressed, and the other qualities of yellowness and hardness are left over as belonging, according to Eddington, to the extra-scientific domain of experience, or, according to Jeans, so far as I can gather, to the domain of illusions.

This idea, as Eddington clearly points out, requires that science is a closed, self-contained system, including all that is metrical in our experiences. But it is difficult to see how the existence of this closed system can be established. Even in the metrical part of our experiences there are phenomena which lie outside it. Take motion, for example. The system includes the motion of a comet, but it does not include the motion of a fly. We need consider none of the non-metrical aspects of the fly, but only its motion as a piece of matter. The matter is made up of protons and electrons, formed into atoms indistinguishable from those of the comet, and its motion can be described completely in terms of space and time. Nevertheless, the motion of the fly is essentially of a different character from that of the comet; it cannot be included within the closed system of metrical physics. Although itself metrical, we can make nothing intelligible out of it unless we associate it with something non-metrical, which we call 'life'; and if anyone thinks that motions associated with life are so entirely incalculable as to be outside science, he should reflect for a moment on the significance of a fly-paper.

The fact is that science is fitted to deal with all experiences which are common to all normal people. Such of these experiences as are metrical in character are largely—but, as we have just seen, not entirely—susceptible to correlation by the present scheme of physics. The others appear to be amenable only to conceptions which are individually different but ultimately of the same character. For these experiences also we employ abstractions and hypotheses. The abstraction of space-time is irrelevant, so we leave it in the phenomena and instead take out such concepts as life, mind, will. These are just as truly abstractions as are space and time; the 'I' of psychology is as valid a scientific idea as the 'i' of mathematics, and has perhaps still more right to be called an imaginary quantity, for it can at least be imagined. Similarly, we employ hypotheses. The hypotheses of protons and electrons are irrelevant, so we conjure up such ideas as organic evolution and subconsciousness. We observe and we correlate by the same methods as those employed in physics, and to a certain extent we can predict events. In every respect our treatment of these experiences has the same character as that of the metrical experiences. It appears to be an arbitrary and extremely inconvenient use of language to call the one treatment scientific and the other not.

Eddington gives an admirable example (loc. cit., pp. 251-252) of the supposed limitation of science to measurement. He describes an imaginary examination question in which an elephant is assumed to slide down a grassy hillside and it is required to find the time of descent. He points out that in solving the problem we do not consider the elephant but merely its mass, namely, 2 tons. Similarly, the hillside is represented by a slope of 60° and a coefficient of friction. Thus the poetry fades out of the problem and only 'pointer-readings' are left.

Now the whole secret of the matter is in the object of the inquiry, which is mentioned as a sort of after-thought: "The question presumably was to find the time of descent of the elephant". Naturally, since the time of descent is essentially a metrical quality, we should expect the relevant parts of the data to be metrical in character. But suppose the further question is put: "To find the damage done to the elephant". "Two tons" is of no use now; the living, struggling, trumpeting animal must be reckoned with. We can do without a knowledge of the slope of the hill, and the coefficient of friction 'leaves us cold'. As before, the poetry fades out of the problem, and it takes the metrical elements with it; but there is still something left, and that something is scientific in character. It involves such things as abrasions and broken limbs; it is approachable with chloroform and X-rays; the problem requires a knowledge of the anatomical structure and physiological processes of elephants—that is, scientific knowledge; and the answer can be stated in scientific terms conveying the same meaning to all normal people.

The division of common experience into metrical and non-metrical parts, of which only the former can be dealt with scientifically, therefore appears too simple. The whole of common experience is open to scientific treatment; part of that which is metrical is included in the physical scheme, and the remainder, together with the non-metrical elements, must be placed in a different scientific category—or perhaps more than one such category. Even this does not exhaust the potentialities of science, for it has an influence outside its own proper sphere, namely, among those experiences which are peculiar to the individual. Such experiences are not in themselves subject to scientific treatment, but, by virtue of a parallelism which exists between them and experiences which are so subject, they cannot be considered as if they were altogether independent of science; or, rather, if we do so consider them, we are closing our minds to much relevant information. It is common knowledge that a man's temper, which is outside the scope of science, shows a close relation with the condition of his digestion, which is very largely, at least, susceptible to scientific treatment.

This point, though sufficiently obvious, is widely overlooked. It is frequently supposed that by defining the field of science we define its influence. The former problem is difficult enough, but not insuperable: the latter is not likely to be solved in our day.

Obituary.

MR. SPENCER LE M. MOORE.

MR. SPENCER LE MARCHANT MOORE, who died on Mar. 14 last at the age of eighty years, joined the staff of the Herbarium at the Royal Gardens, Kew, in 1872, on leaving University College, where he gained the gold medal for botany. Few young men have had the opportunity of training in so brilliant a school of systematists as Kew then offered. Joseph Hooker was director, Daniel Oliver was in charge of the herbarium with J. G. Baker as his second, and George Bentham was in daily attendance, co-operating with Hooker on the "Genera Plantarum", the greatest classic of plant taxonomy. Moore, who was about twenty-one years of age, quickly got to work. Between 1875 and 1880 he contributed a number of papers to the *Journal of Botany*, partly in co-operation with J. G. Baker, on collections from North China, tropical Africa, and the Mascarene Islands, and on various genera of Orchids and Acanthaceæ. In 1877 appeared, in the same *Journal*, the first of his "Alabastra diversa", a series of descriptions and critical notes bearing on genera and species of flowering plants, which, except for a long break from 1880 to 1899, continued almost yearly up to 1929. From 1877 until 1879 he assisted Henry Trimen in the editorship of the *Journal*.

Then came a break. An unfortunate difference with Hooker led to Moore's resignation in 1880, and an attempt to obtain a post in the Department of Botany of the British Museum was unsuccessful. During the ten years that followed, he turned his attention to plant cytology and a succession of papers entitled "Studies in Vegetable Biology" appeared under his name in the *Journal* of the Linnean Society. They dealt with such subjects as continuity of protoplasm, effect of light on protoplasmic movement, and the nature of callus. But he was a lone worker, his papers attracted little attention, and one feels that he had got out of his proper element. However, in 1891 came an opportunity. He joined as botanist a prospecting expedition to Matto Grosso, Brazil, and returned with a large collection, the elaboration of which, comprising many new genera and species, and a general account of the vegetation of the district, filled 250 pages of a volume of the Linnean Society's *Transactions*. It was distinctly his *magnum opus*. In 1894–96, he joined a small gold-seeking expedition to the interior of Western Australia, and his "Botanical Results and Observations on the Nature and Relations of the Desert Flora", also published by the Linnean Society, was a valuable contribution to the botany of a little-known area.

Then in 1898, Moore came to anchor in the Department of Botany of the British Museum as an 'unofficial assistant', and from then until the time of his death worked steadily on the Museum collections. His interests lay chiefly with the families Compositæ and Acanthaceæ and the Australian flora. But there were few families of Dicotyledons of which he had not a working knowledge, and the results of his work appeared in a continuous stream of critical descriptive papers. In the preparation of accounts of important collections received at the Museum, the elaboration of the gamopetalous and apetalous Dicotyledons generally fell to his share. Since William Fawcett's death in 1926 he had been helping towards the completion of the "Flora of Jamaica". He had finished the Compositæ and the greater part of the Rubiaceæ, when a paralytic stroke abruptly ended his work, in his eighty-first year.

Few botanists have left such a full record of critical taxonomic spade-work, or have accumulated so extensive a knowledge of the minutiæ of the genera and species of flowering plants. Spencer Moore's kindly personality and his invaluable help, always ungrudgingly given, will be greatly missed by his former colleagues at the Museum.

A. B. RENDLE.

WE regret to record the death on Dec. 19, at the age of eighty-nine years, of Dr. C. Willgerodt, extra-ordinary professor of chemistry at the University of Freiburg-im-Breisgau. From the *Chemiker-Zeitung* we learn the following particulars of his career. Born at Harlingerodt in 1841, the son of a farmer, Willgerodt was trained as a teacher and spent some years teaching in an elementary school before turning his attention to scientific work. At the Polytechnic at Brunswick, he began to study zoology; but in his twenty-eighth year he moved to Berlin, where, under the inspiring influence of A. W. von Hofmann, he devoted his whole time to chemistry. Two years later he accepted a post as chemist in a colour factory at Elberfeld, and shortly afterwards he became manager of a factory at Opladen. Feeling, however, a desire for further study, he gave up his post and entered the University of Freiburg, where, after graduation, he was appointed to the teaching staff. Willgerodt remained at Freiburg for the remainder of his life. In 1896 he was appointed director of the Technological Institute, and in 1915 extra-ordinary professor of inorganic chemistry and technology. Willgerodt published numerous original papers on organic chemistry, the best known of which deal with the interaction of chloroform, acetone, and caustic alkalis and with the iodoso- and iodoxy-derivatives of benzene.

WE regret to announce the following deaths:

Dr. J. C. Hemmeter, professor of physiology and clinical medicine in the University of Maryland, known for his work on the physiology and pathology of the intestines, on Feb. 25, aged sixty-seven years.

Mr. J. G. Millais, who was the author of many books on natural history and sport and was known for his excellent animal paintings, on Mar. 24, aged sixty-six years.

Mr. P. P. Quayle, physicist to the Phillips Cartridge Company of America and formerly an assistant in the Bureau of Standards, who was a recognised authority on ballistics, on Feb. 21.

Mr. A. J. Turner, principal of the Victoria Jubilee Technical Institute, Matunga, Bombay, author of a number of papers on chemistry, on Mar. 15, aged fifty-six years.

News and Views.

Presidents of the Chemical Society, in their annual addresses, customarily exercise choice of subject between the affairs of the society and matters of purely scientific interest. Prof. J. F. Thorpe, who was this year in the unique position of presiding for the third time in succession over the annual general meeting, divided his address, delivered on Mar. 26, into two parts. In the first part he commented on the Society's progress during the decade in which he has been in intimate touch with its work as treasurer and as president; in the second, which was not delivered at the meeting but will be published in the *Journal*, he will discuss the results obtained at the Imperial College of Science and Technology in researches on the chemistry of the glutaconic acids and on the modified strain theory of carbon ring formation. The retrospect dealt first with the scheme for providing a central building to house various societies connected with mining, metallurgy, and chemistry, and referred to the constitution of an association and its registration under Section 19 of the Companies Act, 1929, whereby powers practically equivalent to those usually granted in a Royal Charter have been secured The association may make no profits, neither may it give any bonus or distribute any money to its members; hence any excess of income over expenditure will lead to a corresponding reduction in the rents paid by the constituent bodies. After careful consideration, a proposal to house the association in the building which has just been erected by Anglo-Properties, Ltd., adjacent to the Imperial Chemical Industries building at Millbank, has been rejected, and recourse has been had to the site originally proposed, which is adjacent to Abbey House, Westminster. The sum of £100,000 in cash must be paid by June 24 next to purchase the lease and sub-leases. An appeal to the Treasury has failed to secure assistance, and a similar appeal to the Pilgrim Trust has met with no response.

Abstracts of chemical literature are responsible for an increasingly severe tax on the financial resources of the two societies—the Chemical Society and the Society of Chemical Industry—by which, through the Bureau of Chemical Abstracts, *British Chemical Abstracts* is published. Prof. Thorpe's presidential address referred to the fluctuations in income and expenditure which arise from this and other causes, and advocated the immediate formation of a reserve fund. Since 1921, the membership of the Chemical Society has remained almost constant at about 3900; during the same period receipts from the sale of publications have been nearly doubled, but the cost of publications has largely increased. In advocating co-operation between *British* and *American Chemical Abstracts* in order to minimise waste of money and energy, Prof. Thorpe said that the decennial index afforded an opportunity for collaboration, and suggested as a first measure the quinquennial publication of a joint index giving references to both sets of abstracts. In an alternative scheme, the cost of the abstracts could be spread over a wider field. Such a publication ought to be of interest to all chemists, and ought to be supported by all chemists, yet some 4000 British chemists are not members of either of the two societies which maintain the service. Institutions desiring to avoid the possibility of curtailment of chemical publication, owing to lack of funds, might be willing to pay to the Bureau of Abstracts a sum per head of all those of its members who do not belong either to the Chemical Society or to the Society of Chemical Industry; every member would then be entitled to receive a copy of the *Abstracts*, and the institutions could have the right to appoint a representative to serve on the Bureau. Before concluding his address and inviting Dr. M. A. Whiteley to unveil a portrait of the first president, Thomas Graham, Prof. Thorpe referred to the prolongation of the life of the Dyestuffs Act, and emphasised its influence on scientific research.

The Imperial Institute has been relieved of its most pressing financial anxieties by the munificent gift by Mr. Benjamin Drage of £36,000, which is to be paid in the course of the next few years and is to be applied to the maintenance and improvement of the Institute. The offer has been made to the Empire Marketing Board, and has been accepted by its chairman, Mr. J. H. Thomas. The Imperial Institute was greatly aided by the annual donation of £5000 by the late Lord Cowdray: the cessation of that contribution and the financial embarrassment of some of the leading supporters among the Overseas Dominions have recently threatened some of the work of the Institute. Mr. Drage's gift will assure its development. The Institute has recently held an exhibition explanatory of the mineral resources of the British Empire, which has shown a happy combination of picturesque dioramas that illustrate graphically the mining operations, collections of the ores and minerals, and statistical diagrams of Imperial and world production and reserves. Mr. Drage has made his noble contribution from his realisation of the value of the Imperial Institute as a national centre for education in the economic resources of the Empire. Sir William Furse is to be congratulated on the growth of public confidence in the usefulness of the Institute, of which Mr. Drage's donation is striking evidence.

In his Friday evening discourse delivered at the Royal Institution on Mar. 27, Lord Rutherford discussed helium and its properties. He opened with a résumé of the dramatic history of the discovery of this element. In 1903 Ramsay and Soddy found that helium was produced by the transformation of radium and, as a result of a series of researches, Rutherford showed that the α-particles which are ejected with great velocity from radioactive atoms were identical with helium nuclei. It is probable that the greater part, if not all, of the helium found in the earth and in the natural gases escaping from the earth owes its origin to the α-particles expelled from the radioactive elements during their transformation in the earth's crust. It now seems clear that the helium nucleus of resultant charge 2 is remarkably stable

and is in some way built up by the combination of 4 protons and 2 electrons. The loss of mass in this combination shows that a very large amount of energy, probably in the form of penetrating gamma rays, is emitted during the process. It can be calculated that the energy released in the formation of one pound of helium from hydrogen corresponds to the energy liberated in the complete combustion of 10,000 tons of coal. There can be no doubt that helium is formed from hydrogen under some, as yet unknown, conditions in the stellar system. However, it has not yet been found possible to produce helium from hydrogen under laboratory conditions.

IN 1914, Lord Rutherford continued, Sir Richard Threlfall suggested to the Board of Inventions of the Admiralty that, on account of its lightness and non-inflammability, helium might prove of great service for balloons and airships. Prof. J. C. McLennan, of the University of Toronto, was asked to initiate experiments to see whether helium could be separated in quantity from the natural gases escaping from the earth in certain districts of Canada which were known to contain about one per cent of helium by volume. Arrangements were made on a semi-commercial scale to purify the helium by liquefying the methane and other gases present. The impure helium was concentrated in the non-liquefying portion. In this way, many thousands of cubic feet of helium were prepared and transported in cylinders at high pressure. About the same time, the Bureau of Mines of the U.S.A. began similar experiments on a large scale, using the natural gases of Texas which were rich in helium. Large quantities of helium were separated by liquefaction methods and the cost of the helium was found to be sufficiently low to use it in airships in the place of hydrogen. The commercial prospects of the use of helium in airships and other purposes has led to a search for rich concentrations of helium. While most natural gases contain less than one per cent of helium, a rich mixture has been recently found in Colorado by boring, which contains more than 7 per cent of helium by volume. A plant has been installed which deals with about 600,000 cubic feet of gas per day. This should give an annual production of helium of 12 million cubic feet. It may be possible that similar rich concentrations may be found on the eastern slopes of the Rocky Mountains in Canada. A small gas field was found a few years ago not far from Toronto which had a content of 0·8 per cent helium. The rights of these wells have been secured for the University of Toronto in order to have an ample supply of helium for cryogenic experiments in its laboratories.

MEMBERS of university staffs are familiar with the inconvenience which results when summaries of theses and dissertations prepared under their supervision or under that of their colleagues are not made and so kept as to be readily accessible. Such a collection of abstracts with particulars of publications by members of the University of Leeds, for the session 1929–1930, has recently been published. Besides proving a useful reference book within the University, it should be welcomed elsewhere as a demonstration of the manner in which one of the primary functions of a university—the acquisition of new knowledge—is being performed. The pamphlet of fifty-four pages covers the work done in the faculties of arts, science, medicine, and technology. One of the theses describes the results of a topographical study undertaken in order to test the historicity of a group of Icelandic sagas; another concerns the phonology of the old Northumbrian texts. The chemical section contains abstracts of theses on such varied subjects as the atomic weight of silicon, the molecular weight of carbon monoxide, aromatic substitution, and catalytic activity. Other work carried out included studies on tobacco mosaic, the growth of *Pinus sylvestris*, biochemical oxidation, the chemical aspects of immunity, experimental carcinogenesis, the behaviour of electrons, the properties of reinforced concrete beams, the ventilating properties of fabrics, the physico-chemical properties of wool-fat, the preparation of phthalazine derivatives, and the emission of infra-red radiation during gaseous explosion.

WE have, from time to time, directed attention, in our columns devoted to "Research Items", to the publications of the Bernice P. Bishop Museum of Honolulu, of which the primary object is the elucidation of the ethnological problems of the Pacific. For some years, the museum has added very considerably to our detailed knowledge of the cultures and physical characters of the inhabitants of Polynesia by the publication of the results of the Bayard Dominick Expedition. Much of this material is still under examination, while other studies are forthcoming. In the meantime, an interesting and intentionally provocative analysis by E. S. Craighill Handy ("The Problem of Polynesian Origins", *Occasional Papers*, No. 8, Bernice P. Bishop Museum) offers a suggestion on the complicated question of Polynesian-Asiatic relationships. We will not attempt here to follow Mr. Handy in the details of his argument, in which he traces the various cultural and ethnical influences from Asia which have penetrated Polynesia in prehistoric, Brahmanical, and Buddhist times; but Mr. Handy's views on the means by which they were carried to Polynesia are interesting. He suggests that the habit of thinking of Polynesian migrations in canoes should be abandoned. Almost certainly, the later Malaysians and Asiatics started their voyages, which were probably accidental, in ships. The effective agent was the strong current which runs between Luzon and Formosa; so strong that "any sailing ship sucked into it is flung out towards Micronesia". It may not be without interest to recall that the late Sir Henry Howorth, shortly before his death, suggested the derivation of certain cultural elements in Polynesia from Tibet, the casual castaway ship being made accountable for their introduction into Polynesia.

PROF. ELLIOT SMITH'S Henderson Trust Lecture on "The Significance of Peking Man" (Oliver and Boyd, pp. 20; 6*d*.), from which we published extracts in NATURE, Feb. 7, p. 202, pays a well-deserved tribute

to the vision and perseverance of Dr. Andersson and Dr. Davidson Black, by which the existence of early man in China has been established. Dr. Black's courageous identification of a new human genus on the evidence of the tooth discovered by Dr. Bohlin at Chou Kou Tien in 1927 is now fully vindicated. Prof. Elliot Smith's survey of the course of events, from the first tentative suggestion of the human or anthropoid character of the tooth bought in Peking in 1903, leading up to the final discoveries, is a valuable record for the future historian of scientific discovery. Not the least of its merits is the credit given the Chinese authorities for their enlightened support—a support which would, no doubt, have been even more helpful had it not been for the unfortunate course of political events. In the circumstances, it was to be expected that the actual specimens should remain in Peking, and that those who wish to study them at first-hand must visit China. The excellent series of photographs, however, with which Prof. Elliot Smith has illustrated his lecture in its published form, gives the reader an opportunity of judging for himself its many remarkable features. Among these, the most striking is, perhaps, the remarkable thickness of the walls of the skull as compared with those of Piltdown man, to which the author refers. A comparative series of jaws brings out the resemblance between those found at Chou Kou Tien in 1927 and the chimpanzoid jaw of Piltdown. As Prof. Elliot Smith says, these jaws have now settled a controversy which had lasted for sixteen years.

One of the chief desiderata of the Zoological Department of the British Museum (Natural History) has recently been supplied by a gift from His Highness the Nawab Sahib of Junagadh of complete male and female specimens of the Indian lion; the specimens comprising perfect skins, skulls, and skeletons of two adult animals. The skins have been placed in the study collection. The Department of Entomology of the Museum has been fortunate in securing the collection of Hesperiidæ (Skipper butterflies) formed by M. René Oberthür, of Rennes, consisting approximately of 60,000 specimens from all parts of the world. The bulk of the present acquisition was originally part of the great collection of butterflies formed by the late M. Charles Oberthür, the greater portion of which, amounting to nearly 800,000 specimens, came into the possession of the Museum in 1897. But to this section of his brother's collection M. René Oberthür was able to add, after he had acquired it, the collection of Hesperiidæ formed by M. Mabille, who was for many years the leading authority on the group. The Department of Geology has received four specimens of the primitive ichthyosaur, *Mixosaurus*, found in the Middle Trias of Edge Island by Mr. N. L. Falcon during an expedition to Spitsbergen in 1927. Two specimens are parts of jaws; another is part of a limb; but the fourth is the almost entire vertebral column, about five feet long. The condition of the vertebræ is excellent, and all the neural spines are preserved and clearly indicate the presence of a small tail-fin. Miss A. Lorrain Smith has presented to the Department of Botany 646 drawings of fungi, lichens, and Mycetozoa made by John Templeton (1766–1825), a well-known Irish botanist. The drawings were given to Miss Lorrain Smith by Dr. Howard Kelly, of the United States, and his letter of gift, stating that the collection "should return home, where it can be studied and where it will serve to bring more credit to its author" than would be possible in the United States, is included.

In modern practice, the heat developed in large electric machines and devices limits the load they can carry and therefore their rating. Elaborate methods of keeping them cool are adopted and they are sometimes placed in the open air. In Great Britain there are many outdoor substations, and this practice is rapidly increasing. Another interesting trend of development is to put them in various kinds of gases and liquids so as to facilitate their cooling. Transformer coils, for example, are often placed in nitrogen and rotating machinery in hydrogen. Many kinds of switchgear are placed in oil or gum. In the *Westinghouse International* for January, a 9375-kilovolt ampere turbo-generator is described, the rotor of which has been running successfully in hydrogen for six months, despite the fact that it has a projecting shaft. It is common practice to run synchronous condensers which have no projecting shaft in hydrogen. It has been found experimentally that using hydrogen instead of air increases the rating of the machine by at least 25 per cent. In addition, the efficiency is found to be 1 per cent greater; also, there is no need to guard against damage being done to the insulation by effects due to corona discharges. Since the machine is hermetically sealed, it can be placed out-of-doors. The hydrogen pressure is kept slightly above the atmospheric pressure, so that the leakage, which tests show to be extremely small, is outwards. In case of any abnormal conditions occurring, automatic signals attract the operator's attention.

The Council of the London Mathematical Society has decided on an extension of the scheme, which was started six years ago, of devoting two of the meetings in each session to a lecture. It has now been decided to devote an occasional meeting to a set discussion on recent advances in a selected branch of mathematics. The first of these discussions will take place at the meeting on April 23 at 5 p.m. at Burlington House. The discussion, which will be on "Recent Work in the Additive Theory of Numbers", will be opened by Prof. G. H. Hardy; he will be followed by Mr. E. Maitland Wright on "New Partition Problems", Mr. A. E. Ingham on "The Method of Brun and the Theorem of Schnirelmann", and Dr. A. E. Western on "Computative Work connected with Waring's Problem". It is hoped that Prof. L. J. Mordell, Mr. S. D. Chowla, Dr. T. Estermann, and Prof. J. E. Littlewood will also take part in the discussion. The second lecture of the session will be given by Prof. J. E. Lennard-Jones at the meeting on May 14. Members of other scientific societies who may be interested are invited to attend these meetings.

IN recent years, many aquatic birds have shown a new spirit of colonisation in Great Britain. The spread of more than half a dozen species of wild ducks, especially in Scotland, has been remarkable. Sharing with the ducks in this great advance movement, and we refer again particularly to Scotland, has been the great crested grebe. But there is evidence that the breeding range of this species is altering in England also, and, if this be so, the sooner exact information about the past and present detailed distribution is collected the better. For with such a firm basis of fact, future movements may be recorded with accuracy and perhaps some of the factors concerned in so general a movement may be elucidated. Naturalists, therefore, would be doing good work if they contributed information to the "Great Crested Grebe Enquiry" of T. H. Harrisson and P. A. D. Hollom. The investigation aims at forming a census of great crested grebes for the whole of Great Britain, and is supported by *British Birds* (Feb. 1931). Schedules to be filled in with desirable data may be obtained from Mr. Harrisson, at Pembroke College, Cambridge.

THE value of red squill powder in the destruction of rats is becoming increasingly recognised. When experiments were carried out in the Zoological Gardens in London some years ago, it was found that the liquid preparation of red squill (a liliaceous plant known also as scilla and sea-onion, *Urginea maritima*) was more trustworthy than powder mixtures. Since 1923, however, the U.S. Department of Agriculture has been experimenting with the powdered forms, and it has been found that a powder of maximum toxicity can be obtained by drying the sliced bulbs at a constant temperature of 80° C. Thus the greatest difficulty in the use of red squill, irregularity of results, has been overcome, and the poison has become the most widely used against rats in the United States. It is greatly in its favour that this rat poison is relatively harmless to human beings and domestic animals; indeed, in field tests, prairie dogs and pocket gophers refused to eat the red squill baits, and in most cases cats, dogs, chickens, pigeons, and pigs either refused to eat poisoned foods or, having eaten, promptly vomited them. One of the authors of the new U.S. Dept. Agriculture *Leaflet* 65, "Red Squill Powder and Rat Control", himself swallowed 15-grain and 40-grain doses of a toxic red-squill powder without untoward results.

TWO recent *Botany Leaflets*, Nos. 15 and 16, received from the Field Museum of Natural History, Chicago, appear to be almost models of their kind. No. 15, on "Spices and Condiments", by James B. McNair, whilst full of information, has a wide general appeal, because the history and romance of these plant products are always kept in view. Writing for the New World, the author emphasises the fact that most of the spices used by man have had their home in the tropics of Asia, whence they have spread all over the globe; the value of all spices shipped directly to the United States averages about twelve million dollars annually. *Leaflet* No. 16, "Fifty Common Plant Galls of the Chicago Area", by Carl F. Gronemann, is also extremely attractive. A brief introduction is well calculated to arouse the reader's interest. All the galls described are clearly illustrated, and although their number is so small, probably any Chicago reader could soon find a few of them near his home. Interest once thus aroused, plenty of references are supplied to help the reader to further knowledge in a little-studied field. It is doubtful whether in strenuous northern America, especially the eastern United States, the amateur naturalist has flourished as he has under English conditions, and these leaflets should do much to encourage the development of the naturalist in the strenuous industrial centre served by the Museum.

THE National Smoke Abatement Society has issued No. 1 of its second volume (23 King Street, Manchester, 1*s*. quarterly), which shows how the problem of atmospheric pollution is being handled in different parts of Great Britain. New ground is being broken by the West Riding of Yorkshire Regional Smoke Abatement Committee in setting up a scheme for training and certification of stokers and boiler attendants. In its first year, candidates from eleven centres are already expected to sit for examination, and there are indications of more next year. It is hoped that improved training will raise the status of the fireman, and by more intelligent operation, promote not only efficiency and economy, but also reduce the nuisance which is so great in the textile areas. The journal reveals great efforts of smoke abatement reformers, but the difficulty is to secure the active co-operation of the smoke producers, both domestic and industrial.

THE United States National Museum, the expenses of which have been provided by Congress since 1877, cost during the year ending June 30, 1930, a sum of 762,514 dollars, 14,490 dollars above that of the preceding year. More than half a million specimens were added to the collections, including a great ball of crystal $12\frac{7}{8}$ inches in diameter and weighing $106\frac{3}{4}$ pounds, believed to be the largest perfect crystal sphere in existence. The specimens now covered in the museum catalogues number $12\frac{1}{2}$ millions, of which more than 9 millions belong to the Department of Biology, and 2 millions to Geology. The annual attendance remains very high, the visitors approaching the two-million mark, and it is remarkable that in the course of four years the annual number of visitors to the Arts and Industries Section, which now stands at 863,000, should have increased by half a million, while other sections show relatively small increases.

THE United States Geological Survey has republished a general introduction to the Coalfields of the United States and a chapter on the Coalfields of Ohio (*U.S. Geol. Surv. Prof. Pap.* 100), which were first published in 1917. At that time it was planned to publish similar descriptions of the coalfields of the various States; this plan has now been abandoned, but it has been considered worth while to republish the two chapters in question. The general description of the coalfields by Mr. Campbell occupies some thirty-three pages, whilst that of the

coalfields of Ohio by Mr. Bownocker occupies some sixty-one pages; for the purposes of the general student of the distribution of the world's coalfields, the former is undoubtedly of far greater importance, and the United States Geological Survey is to be congratulated upon its decision to republish this information and thus render it more readily accessible.

THE spontaneous combustion of coal is a source of trouble to those concerned with the winning, transport, and storage of coal. At air temperature, oxygen may be absorbed, causing a rise in temperature, but after a time, smouldering begins. The Safety in Mines Research Board has issued a report (No. 63) of an investigation by H. E. Newall and F. S. Sinnatt on the "Propagation of Combustion in Powdered Coal". This smouldering of coal dust can be propagated at temperatures above 130° at a speed which depends on conditions, but can be so low as 5 in. per hour. It was shown that appreciable quantities of hydrocyanic acid were evolved on combustion at 500°-600°, which suggests the existence of an additional and unsuspected hazard associated with spontaneous combustion.

IN the December issue of the *Quarterly Review of Biology* is the fifth annual report on the cost of biological books. This deals with the books received during the year 1930. The biological books published by the United States Government stand lowest in the comparative list of prices. France continues to produce the cheapest commercially published scientific books, costing on the average, at 0·47 cent per page, less than half as much as those of any other country; while there is a continued increase in the prices of German books, which average 1·82 cents per page, being far above that of any other group except the English-American books, in the cost of which (at 1·91 cents per page) are included transportation charges and tariff. The cost of English biological books (1·13 cents per page) decreased slightly as compared with 1929.

WATSON'S *Microscope Record* for January (No. 22) contains useful practical articles on "Microscopical Methods for Mycetozoa", by J. M. Coon, and on "Cements and Finishes for Microscopical Preparations", by W. D. Grier. C. H. Oakden continues his notes on early photomicrographers. Details are given of contributions by, among others, Fox Talbot (1839), Hogg (1841), and Diamond, the first secretary of the Photographic Society (now the Royal Photographic Society). Draper, who in 1840 made the first astronomical photograph of the moon, between 1851 and 1856 took several daguerreotypes of microscopical objects. Donne in 1884 issued an "Atlas d'anatomie microscopique", containing no less than eighty photomicrographs printed from daguerreotype plates etched with hydrochloric acid. The plates, being of very soft metal, were useless by the time fifty impressions had been taken. This "Atlas" is the first book of photomicrographs published.

THE Daniel-Pidgeon award for 1931 of the Geological Society of London has been made to Mr. W. Q. Kennedy, who proposes to investigate certain porphyritic and non-porphyritic basic intrusions of composite character in the Tertiary province of the west of Scotland.

AT the annual general meeting of the Ray Society on Mar. 20, the following officers were re-elected: *President*: Prof. W. C. M'Intosh; *Treasurer*: Sir Sidney F. Harmer; *Secretary*: Dr. W. T. Calman. Mr. D. J. Scourfield was elected a vice-president, and Prof. F. Balfour Browne and Mr. Charles Oldham were elected new members of Council. It was announced that the first volume of Dr. Gurney's monograph on "British Copepoda" is in the press and will form the Ray Society's issue for 1931. The Council appeals for further support to enable the Society to continue its work of publishing natural history books which otherwise would be unlikely to find means of publication.

THE Glass Manufacturers' Federation has arranged an exhibition of British glass and glassware to be held in the exhibition hall of Messrs. Selfridge and Co., Ltd., Oxford Street, London, on April 13–18. Among the ten sections into which the exhibition will be divided are safety and 'health' glass; chemical, scientific, laboratory, medical, and machine glassware; gauge glass, glass tubing and rods, and neon signs; optical glass, lenses, and lighthouse glass; electric lamp bulbs for lighting and scientific purposes. Among the demonstrations which have been arranged are glass blowing, 'health' glass, invisible rays, and glass-eye making.

AN exhibition is being held in the Czechoslovak National Museum, Prague, of the works of the great seventeeth century astronomers, Johann Kepler and Tycho Brahe. Though neither was a native of Bohemia, each spent the most important and fruitful period of his life in Prague. Each, too, was in turn Astronomer-Royal to Rudolph II., who made Prague a centre of art and learning. Kepler was there during the years 1600 to 1612, and taught at the German university. The exhibition contains material drawn from within the borders of Czechoslovakia, especially from the libraries of Strahov Monastery and the University of Prague, the State Observatory, and the private collection of the Fric family.

THE preliminary programme of the congress of the Royal Institute of Public Health, to be held at Frankfurt-on-Main on May 19–24, has recently been issued. Amongst much information, including a preliminary itinerary, is the list of sectional presidents. They are: Section (1), State medicine and municipal hygiene, Lord Moynihan and Prof. M. Taute; Section (2), architecture, housing, and town-planning, Prof. Patrick Abercrombie and Dr. O. Weigert; Section (3), industrial hygiene, Viscount Leverhulme and Dr. Arthur von Weinberg; Section (4), women and children and the public health, Viscountess Erleigh and Prof. H. von Mettenheim; Section (5), tuberculosis, Dr. David Davies and Prof. L. Brauer; Section (6), pathology, bacteriology, and biochemistry, Prof. Theodore Shennan and Prof. W. Kolle.

IN his presidential address on Mar. 22 to the Glasgow Archæological Society, Mr. Ludovic Mann described

some recent discoveries in the west of Scotland. Many of the relics were exhibited. A notable find was that of a Roman warrior buried, after cremation, on the Wigtownshire shore, associated with three Roman pottery vessels, two of *terra sigillata*: two iron spearheads; an iron sword; some iron fragments in the nature of plating; a bronze ring; an iron ring containing an intaglio of pale green chalcedony engraved with the figure of a female, robed and holding in her left arm what appears to be a palm branch.

A SHORT handy list (B.7) of second-hand books on botany, herbals and medicinal plants, gardens and gardening, fruits and fruit culture, trees and shrubs, agriculture and husbandry, has been issued by Messrs. Francis Edwards, Ltd., 83 High Street, Marylebone, W.1.

MESSRS. W. H. Robinson, Ltd., 16 Pall Mall, S.W.1, have just issued a "Catalogue of Rare Books", No. 32. Most of the books listed are of a general character, but there are some of scientific interest, for example the first edition of Malthus's "An Essay on the Principle of Population, as it affects the future improvement of Society", several volumes of the Hakluyt Society, and a manuscript in 3 vols. of lectures on chemistry by Prof. Joseph Black, of Edinburgh.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A handicraft instructor at the Anerley Residential School—The Education Officer (S.S.6), County Hall, Westminster Bridge, S.E.1 (April 11). A junior lecturer in commerce in the University of Liverpool—The Registrar, The University, Liverpool (April 13). A lecturer in education in the University of Sheffield—The Registrar, The University, Sheffield (April 18). A junior scientific officer under the directorate of scientific research of the Air Ministry, for research in connexion with electrical equipment, especially with reference to electrical ignition apparatus—The Chief Superintendent, Royal Aircraft Establishment, South Farnborough, Hants (April 18). A probationer naturalist on the scientific staff of the Fishery Board for Scotland—The Secretary, Fishery Board for Scotland, 101 George Street, Edinburgh (April 20). An assistant in the Brighton Public Museum with a knowledge of ornithology and taxidermy—The Director, North Gate House, Church Street, Brighton (April 27). An advanced studentship in education in the University of Manchester—The Registrar, The University, Manchester (May 1). An additional assistant pathologist in the Public Health Department of the Shanghai Municipal Council—John Pook and Co., 68 Fenchurch Street, E.C.3.

Our Astronomical Column.

Early Images of Pluto on Flagstaff Plates.—*Harvard Card*, No. 148, reports that images of Pluto have been detected on two plates taken at the Lowell Observatory in the spring of 1915. That was the year in which Prof. P. Lowell's "Memoir on the Trans-Neptunian Planet" was published, and it is quite likely that he examined these plates himself; they were presumably taken specially for the search. It is much to be lamented that the images were not detected at the time, as Prof. Lowell would then have been cheered, before his death, by knowledge that his prediction was successful. Incidentally, the number of pre-discovery images of Pluto that were undetected at the time (eleven are now known) emphasises the skill and alertness of Mr. Tombaugh in making the discovery so promptly after inspection of the plates of January 1930. Dr. Bower has corrected the orbit of Pluto by computing the planetary perturbations, and gives the following residuals (Observed—Calculated) for the earliest three positions:

			R.A.	Decl.
1914	Jan. 23	Königstuhl	+ 2·9″	+ 0·4″
1915	Mar. 19	Flagstaff	+ 3·0	− 2·7
,,	April 7	,,	+ 3·8	− 4·8

He asks that any observers who possess plates that might contain images of Pluto should send him the dates of exposure; he would then calculate the perturbations and send an accurate position to assist in the search upon the plates. His address is the Students' Observatory, Berkeley, California.

A Very Distant Spiral Nebula.—A *Daily Science Bulletin* issued by Science Service, Washington, D.C., dated Feb. 25, announces that M. L. Humason has photographed with the 100-inch reflector at Mount Wilson the spectrum of a very faint nebula discovered by W. H. Christie; its position in the sky is not stated. The spectrum shows a shift of the lines towards the red, corresponding to a recession of 17,600 km./sec., and an estimated distance of 120 million light-years. This is by far the most distant nebula the distance of which can be regarded as 'measured'; but it will be remembered that when Dr. Hubble published his determination of the distances of the Andromeda nebula and Messier 33 as nearly a million light-years, he estimated that the faintest nebulæ that could be reached with the 100-inch were distant about 150 million light-years. The estimate of distance derived from the spectral shift is independent of the view taken as to the reality of the recessional movement. Prof. A. Einstein, the Mount Wilson astronomers, Sir James Jeans, and others regard this movement as only apparent, arising from the properties of the four-dimensional space-time continuum; but Prof. de Sitter (supported to some extent by Sir Arthur Eddington) considers that the recession is really going on. Prof. Einstein is now at Mount Wilson, and naturally he is following this investigation with great interest.

Heights and Diameters of Lunar Craters.—The *B.A.A. Jour.* for January contains a statistical paper by T. L. MacDonald, in which he studies the altitudes of the walls surrounding the craters, measured both from the external plain and from the crater floor, and correlates them with the diameters. Detailed measurements are given for about two hundred formations. The graphs that are given show that the height varies approximately as the square root of the diameter, so that the plotted points lie on a parabola. To a diameter of 84 km. corresponds a height of 4·4 km., and to 24 km. corresponds 2·8 km. Craters in the region between Tycho and the south pole (which the author calls the continental region) are unusually high for their diameter. A drawing of an ideal lunar crater (in which the vertical scale is much larger than the horizontal one) shows that the slope on the inside of the crater walls is much steeper than on the outside.

Research Items.

Folk-memory in Crete.—The contents of vol. 41, pt. 1, of *Folk-Lore* include the presidential address to the Folklore Society by Prof. R. M. Dawkins at the close of his term of office. It illustrates the general principles of the evidential value of folk-memory in application to a specific area in which it is possible to check tradition by bringing it into relation with historical records. There is no popular tradition now alive in Crete which reaches back to Minoan times, and in fact it does not go back earlier than the name Hellen. The preservation of place-names and, indeed, of the language—a popular form banned by literature and learning—is in itself an effort of folk-memory. But until recently the name Hellen meant pagan and the place-names which preserved a long tradition have been obliterated by recent changes. Of Christian history, a memory, if mistaken, is enshrined in the tomb of Caiaphas. Of Byzantine history there is little to show. One tradition, though false, preserved a record of the voyage of Eudocia in 443 A.D.; while another, entirely false, related to a Byzantine lady of the ninth century. Of the Arab occupation there were no stories; but the story of the "Twelve Archons" refers to the Byzantine reorganisation of Cretan society from Constantinople after the reconquest. The ballads and legends of Digenis, a hero of the struggle against the Saracens on the Asiatic frontier, are also referred to Byzantium. The raids of pirates made considerable impression on the popular mind, and the Venetian supremacy was also remembered; but it is with the Turkish occupation that popular memory really begins, and to it popular tradition and legend predominantly belong.

A Ritual Use of Rock Paintings in Tanganyika.—In the March issue of *Man*, which is devoted entirely to Africa, Mr. A. T. Culwick describes a ritual at Bahi. In certain rock-shelters are rock paintings about which Wagogo tradition relates that Wamia, who was driven out by their earliest ancestor Kimanchambogo, and Amankara made them, when they sacrificed cows, using the fat of the victims to make the lines. Now, therefore, the Wagogo, although they know nothing of the meaning of the paintings, during a drought go to these rock-shelters, which they regard as sacred, and *tambika* there—that is, offer up a special form of sacrifice in which the entrails are taken out of the victim and thrown at the sacred object. The fat of the animal is used to brush over the painting, following the lines drawn by Wamia. The present Wamia tribe, who are said to have been an offshoot of the Masai, have funeral rites of an unusual type. When a distinguished man or woman dies, a rock is *tambika'd*. All the elders assemble, bringing with them a black robe, a black sheep, and black cow. They drink beer, which they then spit out on the rock. The fat of the sacrificed animals is melted and with it a picture of the dead man is drawn on the rock with some of his personal possessions, such as cattle, gourds, pestles and mortar, ornaments, etc. The pictures are then covered with branches and all the people of the village are called for a feast and to drink beer. After this, the elders pray to the deceased, asking for rain in return for their presents. The entrails, with the black robe and some tobacco, are left at the foot of the rock. A medicine man is always represented as a snake.

Iodine Supply and Goitre.—Investigations undertaken in the United States, Switzerland, and New Zealand indicate that there is a correlation between the level of iodine intake and the prevalence of endemic goitre. In the same three countries, it is reported that the administration of iodine in goitre areas has been followed by a marked decrease in the incidence of the disease. In England, the incidence of goitre among school children aged 13-14 years varies, in rural areas, from 0·4 per cent in Essex to 24·5 per cent in Somerset, and in towns from 0·1 per cent in Middlesbrough to 17·2 per cent in Preston. In view of these differences, Dr. J. B. Orr has undertaken a survey of the iodine content of foodstuffs in representative areas (Medical Research Council, *Special Rep. Series*, No. 154). The substances selected for analysis were soils and pastures, milk and eggs, all from the same farms and fields so far as possible, locally grown cabbages and potatoes, blood from local sheep and their thyroid glands. The results obtained are inconclusive. The iodine supply, as judged by the content of milk, eggs, and cabbage, is higher in the Scottish area, which is known to be goitre-free, than in the English counties, where goitre is to a greater or less extent endemic. On the other hand, there is no indication whatever of any definite difference between those areas in England with a low goitre incidence and those reputed to have a high goitre incidence.

Life of the Spider.—A notable contribution to our knowledge of the biology of spiders has been made by Dr. P. Bonnet (*Bull. Soc. Nat. Hist., Toulouse*, **59**, 237-700; 1930). In seven years, 1598 spiders of ten different species have lived under his care and no less than 522 have been raised from the egg to the adult. This has enabled him to show that the number of moults during growth—4 to 22—depends only on the size of the spider, while the time between two moults depends more on the temperature and food supply than on age. He describes a complex mechanism for the autotomy of injured limbs and shows that this cannot always be an involuntary reflex act. Regenerated limbs require three moults to attain their normal size; the process of such regeneration is also described fully. Some of his spiders achieved the regeneration of all eight legs simultaneously.

Craniology of the Dog.—T. Marchlewski (*Bull. Internat. Acad. Polon. Sci. et Lettres*, No. 7-8, B. 2; 1930) discusses the relationships between the diverse groups of breeds of dogs, and concludes there are three clearly defined types as shown by their skull characters. The *Canis leineri* or greyhound group is a uniform group sharply distinct from all other groups of dogs. The *C. optimæ matris* group is less clearly defined, shows no definite affinities with the greyhound group, and is formed by the narrow-headed, long-snouted collie type and by another type represented by the Alsatian wolf-dog. The *C. decumanus* type, the primitive hound or gun-dog type, has a long cranial region and comparatively high crested skull, narrow cranium and moderately wide forehead, and moderately long facial region. This seems to be the type from which have been gradually evolved, with the influence of crosses of the greyhound and the collie type, the highly bred types of pointers.

A New Mounting Medium.—G. D. Hanna (*Jour. R. Micr. Soc.*, vol. 50, pt. 4; 1930) describes under the name "Hyrax"—a derivative of naphthalene—a new mounting medium for microscopic preparations of diatoms. It is a resin of pale straw colour, its refractive index is 1·82, and it is soluble in benzene, xylol, and some other organic solvents, which are

easily expelled from the mounted preparation, by gentle heat. In slides exposed to sunlight, the medium darkens " to about the colour of old balsam ", but in those kept in cabinets, the medium remains " practically water-white ".

Hatching of Insects.—E. K. Sikes and V. B. Wigglesworth (*Quart. Jour. Micr. Sci.*, vol. 74, pt. 2; 1931) record observations on the hatching spines present on the embryonic cuticle of bugs and lice. The mechanism of hatching is described for a flea, the meal-worm, a grain-moth (*Sitotroga*), *Lucilia*, the bed bug, and a louse (*Polyplax*), and the general mechanism of the hatching of insect eggs is discussed. The embryo increases in size very rapidly before hatching by swallowing the amniotic fluid, and thus acquires a better purchase for its operations against the chorion. In every case, the force employed to break open the egg appears to be muscular. The swallowing of air may also play an important part in the emergence of the larva. The authors devote particular attention to the first appearance of air in the tracheæ of the larva. This occurs in three different ways—(1) the surface of the larva dries while still in the egg, and the tracheal system fills, before hatching, from the outside air, for example, *Ceratophyllus*, *Tenebrio*; (2) the larva at the time of emergence is enclosed in a cuticle which retains a layer of fluid, so that air has access to the tracheæ only when this embryonic cuticle is shed, that is, after hatching, for example, *Cimex*, *Polyplax*; (3) the tracheal system fills with gas while the larva is still bathed in the fluid contents of the egg, that is, it fills with the gases which were in solution, for example, *Lucilia* and the grain-moth. It is suggested that the fluid in the tracheæ, which has passed in previously from the tissues, is absorbed by the osmotic pressure of the tissue fluids, and that, since this pressure is increased by muscular activity, air appears earliest in those insects which show the greatest activity while in the egg.

Edible and Poisonous Fungi.—It is with pleasure that we note the appearance of a third edition of " Edible and Poisonous Fungi " (*Bulletin* No. 23, Ministry of Agriculture and Fisheries, London, 1930, 2*s*. 6*d*.). The volume has always been useful to the country person, giving him an element of security in gathering fungi for food purposes and doing much to eradicate the numerous superstitions which have been built up around poisonous toadstools. The present edition has been improved by the substitution of more typical illustrations, and four more common species have been described. There is little danger of the non-technical mind confusing any of the edible species, with the possible exception of *Amanita rubescens*, which is probably not sufficiently distinct from the poisonous *A. muscaria*. The descriptions are lucid and a short glossary is given.

Microchemical Recognition of Saponin in the Plant.—Robert Fischer and his colleagues are developing a new technique for this purpose. Their methods and results are described in the *Sitzungsberichte* of the Vienna Academy of Sciences, Abt. I., vol. 139, 1930, pp. 321-354. Essentially the method consists in covering a section with a gelatin solution containing salt, at a definite *p*H, by addition of phosphate buffers, and mixed with defibrinated blood or washed red blood corpuscles before it has set. The section must be completely covered by the gelatin, when, if saponin is present and diffuses out of the section, a clear region will be seen to develop around the section owing to its hæmolytic action. By the different behaviour of saponins in gelatin at different *p*H, it is claimed that different types of saponin can be recognised. Solanin is also recognised by the fact that it is put out of action by cholesterol, if the section is boiled in a solution of this substance, whilst the cholesterol-solanin complex is apparently broken up and the solanin again released by treatment with boiling xylol. The distribution of saponins in various Caryophyllaceæ and Solanaceæ is examined by these methods.

Fossils of the Samana Range.—An account of the palæontology and geology of the Samana Range in the North-West Frontier Province of India has been prepared by Lieut.-Col. L. M. Davies and others (*Palæont. Indica*, N.S., **15**, 1-8; 1930). The range consists of a single anticline crossed by two faults. The Jurassic is represented by beds which appear to be either Upper Bathonian or Lower Callovian, and perhaps by Upper Jurassic. In the Cretaceous there is definite evidence for Neocomian and Albian horizons. Lower Eocene beds are well represented and correspond to the Ranikot series. The Jurassic and Gault Brachiopods are described by Miss H. M. Muir-Wood; the Albian Echinoids by Miss E. D. Currie; the Albian Gasteropods and Lamellibranchs by L. R. Cox; the Neocomian and Albian Ammonoids by L. F. Spath. Of the Lower Eocene fauna, the Foraminifera are described by L. M. Davies, the corals by Prof. J. W. Gregory, and the Mollusca by L. R. Cox, who gives an account of the palæogeographical conditions of the period.

The Banket of the Witwatersrand.—An important paper, stimulated by Dr. L. C. Graton's recent advocacy of a hydro-thermal origin for the gold deposits of the Rand, was read by Dr. L. Reinecke at the meeting of the Geological Society of South Africa on Dec. 8, 1930, and will appear later in the Society's *Transactions*. Dr. Reinecke shows that the orientation of the pebble axes, the inclination of cross-bedding, the arrangement of the conglomerate lenses, and the thinning and gradual decrease of grade-size from north-west to south-east proves that the Main Reef Leader of the Far East Rand was laid down by currents flowing from the north-west, and not, as Graton supposes, by wave action. The Witwatersrand system also differs from marine formations in its lack of calcareous members. The whole assemblage is shown to resemble in a very remarkable way that of the Siwalik system of northern India. The evidence of its having been deposited by streams on the lower piedmont slopes and flood-plains of a large river system appears to be quite conclusive. Orogenic conditions resembled those which obtained during the deposition of the Siwaliks; but the climate was wetter and colder on the Rand than in the sub-Himalaya. Dr. Reinecke also records that he has been unable to find any relation between the distribution of gold in the reef and the folds, faults, or fractures that affect the system or the dykes that have intruded upon it, with the exception that in places certain zones of payability have been displaced by post-ore faulting. The hydro-thermal hypothesis seems to be definitely untenable in the light of the evidence now presented.

Quiet-day Magnetic Variation.—In a paper in the March number of the *Proceedings of the Royal Society*, Prof. S. Chapman and Mr. J. M. Stagg present an analysis of the variability of the quiet-day diurnal magnetic variation for the stations at Eskdalemuir, Greenwich, Ebro, San Fernando, Batavia, and Mauritius. The ranges of the variation change from day to day irregularly, but there is a definite correlation between the changes in different elements and at different stations, the correlation being greater the nearer the stations. Very quiet days often occur in sequences of two or more, and there is also a tendency

for abnormalities of range to persist for several days. The interpretations which are put upon the results—the labour of obtaining which has been, naturally, extremely heavy—is that there is both a world-wide cause governing the changes, this being probably the conductivity of an upper atmospheric layer due to a solar ionising agency, and a regional cause, which may be a local irregular distribution of temperature and density in the upper atmosphere.

Discontinuous Sorption by Porous Solids.—During the past few years, considerable evidence has been collected by Prof. A. J. Allmand to show that there is an essential discontinuity in the process of sorption of vapours by charcoal. The isothermals (vapour pressure plotted against quantity of vapour which has passed into a condensed phase in conjunction with the absorbing body) show many small breaks which are considered not to be due to experimental error. The present position with regard to this important question is reviewed by Prof. Allmand and Mr. Burrage in the March number of the *Proceedings of the Royal Society*, and in a very full examination of their own results in relation to those of other workers, it is concluded that no discrepancies arise. Scrutiny of results published by others indeed shows some comparable inflections of curves. Some new results are also presented in this paper for silica gel, which also contain evidence for discontinuity, and it is pointed out that there are theoretical reasons for expecting that it should occur. The authors remark that the experimental results make it even clearer than before that only work with plane or relatively plane surfaces is likely to yield information of value about the fundamental adsorption process, a complex porous sorbent like charcoal being inapplicable for this purpose.

Impact of Spheres.—A series of investigations has recently been carried out by Dr. J. P. Andrews on the impact of spheres (*Proc. Phys. Soc.*, Jan. 1, 1931, and earlier papers). Interest in the problems of impact dates back at least as far as Newton, who gave his law of restitution in the Scholium to his Laws of Motion. Actual theories of impact centre for the most part round either the wave theory of Saint-Venant or the pseudo-statical theory of Hertz. The subject has in the past aroused the interest of numerous investigators; few problems have the wide appeal that this possesses alike for the physicist, the engineer, and the mathematician. The most widely known of these investigations is undoubtedly the famous 'guillotine' series carried out by P. G. Tait and commemorated in the Guillotine Room of the Physical Laboratory at the University of Edinburgh. The ordinary mathematical theory of elasticity, based on a linear connexion between the stress tensor and the strain tensor, is competent to give an opinion on phenomena conforming to its range of limitations; but it makes no pretensions of prognosticating any resulting permanent set, though it might adumbrate the nature of secondary phenomena. In the experiments carried out by Andrews on metal spheres, it appears that the permanent set takes a shape suggestive of a lunar crater. There is a distinct depression, with a rather uneven and somewhat curved floor, surrounded by a raised rim. The phenomena had been previously observed by Sir C. V. Raman and other investigators. The results derived from experiments with low velocity of impact substantiate Hertz's theory that the time of impact is inversely proportional to the fifth root of the velocity. An empirical law is given for the duration of impact in other cases, and a hypothesis is framed to explain the various results. The essential feature of the hypothesis is that the pressure is constant at all points of the deformed area; it affords an explanation in a region where the exact mathematical theory is inadequate.

Atomic Weights of Nitrogen and Silver.—The atomic weight of nitrogen by the gravimetric method is intimately related to that of silver through the ratio $Ag : AgNO_3$. More recent measurements of the limiting density of ammonia have given accurate values with respect to hydrogen, and other lines of evidence show that the value (referred to O as 16) is very nearly 14·008 (the oxygen standard is the isotopic mixture). Baxter and Greene in the February *Journal of the American Chemical Society* describe the determination of the ratio $Ag : NH_3$, which with the ratio $Ag : NO_3$ gives the ratio $NH_3 : NO_3$. This, with the assumption of the H : O ratio, makes possible the calculation of the atomic weight of nitrogen. The principle of the method had been applied by Stas. A weighed quantity of ammonia adsorbed on dehydrated chabazite was evaporated into dilute hydrochloric or hydrobromic acid until the acid was exactly neutralised. The halogen content of the solution was then found by nephelometric comparison with the purest silver in the usual way. Great precision in the neutralisation end point could be attained by using methyl red or litmus as indicator. The ratio $NO_3/Ag = 0·57479$ was assumed. The ratios $Ag : NH_3 = 6·33401$ and $NO_3 : NH_3 = 3·64073$ give $N = 14·0085$ (isotopic mixture of oxygen = 16). These numbers are not corrected for a very small amount of water in the ammonia, and on the whole the final outcome is regarded as valuable corroborative evidence that the atomic weight of nitrogen is very close to 14·008. If nitrogen is taken as 14·0078, the atomic weight of silver will be 107·879, whilst $N = 14·008$ gives $Ag = 107·880$ from the $Ag : NH_3$ ratio and 107·879 from the $Ag : NO_3$ ratio.

Oxygen Films on Tungsten.—Langmuir and Villars in the February *Journal of the American Chemical Society* describe a method of studying the rate of loss of oxygen from an adsorbed film on tungsten, as well as of detecting its presence in a gas, which consists in observing the effect on the electron emission of a tungsten filament, sensitised by the presence of a minute trace of cæsium vapour (10^{-6} mm.). Under properly chosen conditions a monatomic oxygen film makes its presence known by increasing the emission a million-fold. By this method, the heat of evaporation of oxygen from the adsorbed layer was calculated as 162 k.cal. per gram atom. The method of preparing the filament and the experimental procedure are described in the paper, and it is suggested that the method, which is not in general use, may be capable of much wider application in chemical investigation. The results also show that adsorbed oxygen films on tungsten surfaces are held by enormous binding forces, very much greater than those corresponding to the heat of dissociation of the oxygen molecule. The method makes use of the fact previously discovered by Langmuir and Kingdon that a minute trace of cæsium vapour may produce an electron emission from heated tungsten up to 640° abs. many billion-fold greater than that from pure tungsten. At higher temperatures this emission passes through a maximum at 715° abs. and decreases with further rise in temperature. This drop in emission is due to the evaporation of the cæsium from the surface. The oxygen increases the stability of the cæsium film, holding it much more firmly than tungsten does, and the effect of the presence of an oxygen film is to hold cæsium atoms which would otherwise evaporate under the same conditions of temperature and pressure.

Grassland Research in the British Empire.

THROUGHOUT the British Empire there are vast tracts of natural pastures which produce herbage of an inferior nutritive value. A large body of evidence has been accumulated in recent years to show that this low nutritive value is to be correlated with deficiencies of inorganic constituents, such as calcium, phosphorus, and chlorine, in the herbage, a condition which is the outcome of growth on mineral-deficient soils. Animals ranging over these pastoral areas and subsisting exclusively on such mineral-deficient herbage, display a low rate of growth and production compared with what is possible on good cultivated pastures. With this decreased growth rate are usually associated lowered fertility and susceptibility to various forms of disease.

During 1926, the committee appointed by the Economic Advisory Council to consider the question of the mineral content of natural pastures recommended that practical investigations should be carried out in a suitable colony or dependency with the view of ascertaining whether the nature of such deficiencies could be determined and the diseases due to them prevented. Following this recommendation, a scheme of research was inaugurated which serves as a model of successful co-operative effort. Kenya Colony was selected as the site of the investigations, and Dr. J. B. Orr, director of the Rowett Research Institute, Aberdeen, assumed the general scientific direction. The Empire Marketing Board rendered signal help by placing generous funds at his disposal. Close and enthusiastic co-operation was established between his own staff of research assistants, some of whom worked in Aberdeen and others in Kenya, and the staff of the Agricultural Department in Kenya Colony. In addition, valuable assistance was given by settlers in the colony, many of whom provided animals and facilities for feeding experiments.

The initial outcome of these important investigations is revealed in the Report now before us, which has been drawn up by Dr. Orr in association with Mr. A. Holm, director of agriculture, Kenya.* Though the main scheme of work is still in its early stages, the results so far obtained are of the highest economic significance and amply justify the trouble which has been taken to secure them.

It has been shown that the most striking deficiency in the natural pastures of Kenya is that of phosphorus. Indeed, in one district, Molo, the deficiency of this element is as great as that found in certain areas of South Africa, where it is the cause of disease in cattle. On the other hand, in another district, Naivasha, the pasturage, apart from deficiency in sodium and chlorine, is as rich as the herbage of good British cultivated pastures. The application of different fertilisers in the most deficient area increased the yield of herbage from 25 per cent, where common salt only was used, to as much as 400 per cent where nitrogenous and phosphatic fertilisers were employed. The provision of small amounts of the deficient minerals to animals grazing these areas was followed by an increase of 30 per cent in the yield of dairy cows, 10 per cent in the rate of growth of lambs, and about 10 per cent in the weight of the fleeces of sheep.

It was discovered that 'Nakuruitis', a local disease resembling the 'bush-sickness' of New Zealand, could be prevented by allowing animals access to a mixture of common salt and iron oxide. This method of prevention is now being applied with successful results on several farms in Kenya, oxen being kept in good condition for at least a year, whereas formerly, without the use of this simple salt lick, it was impossible to keep them free from the disease for longer than six months without sending them away for a period of grazing in another district.

H. E. WOODMAN.

* Economic Advisory Council: Committee on the Mineral Content of Natural Pastures. Sixth Report. Pp. 66. (London: H.M. Stationery Office, 1931.) 1*s.* net.

Medicinal Cod Liver Oil.*

ALTHOUGH the medicinal value of cod liver oil has been known for 150 years, it is only recently that it has been attributed to the presence of vitamins A and D. It is now known, moreover, that different samples of oil vary widely in their vitamin potency as well as in their more obvious chemical and physical characteristics. The principles underlying the production of a fine medicinal oil of high activity should be established so that consumers can always be certain of obtaining full benefit from its administration. The recently issued Empire Marketing Board Report by Profs. J. C. Drummond and T. P. Hilditch provides specifications for cod liver oil which are based on the examination of a large number of samples over several years, and makes recommendations for suitable methods of manufacture.

The investigators examined oils from Newfoundland, Scotland and the North Sea, Iceland, and Norway, obtained at different seasons, for vitamin potency, colour, and fatty acid content, and estimated their saponification and iodine values: oils from other fish were also compared with cod liver oil. Vitamin A was estimated both by the growth test on rats and by the antimony trichloride colour test: in a series of oils very fair agreement between the two methods was obtained, so that the quicker and simpler colour test was used during the greater part of the research as an estimate of the vitamin A potency. Using standard conditions, the results can be expressed in Lovibond blue units; it was not found possible to express the results of assays by the biological method in units, owing to the errors of the animal test. Vitamin D was estimated by the degree of deposition of calcium at the ends of the long bones of rachitic rats as observed under X-rays and following staining with silver nitrate (the 'line test'): the assays were carried out against the standard preparation of irradiated ergosterol employed by the Pharmaceutical Society and the results expressed in terms of the Coward antirachitic unit.

The Newfoundland and Icelandic oils had the highest vitamin potency, the Norwegian the lowest, with the Scottish intermediate, but usually of the same order of activity as the latter. The vitamin A and vitamin D potencies were usually parallel.

A detailed chemical examination of the constituent fatty acids of cod liver and other oils was made: the methods and results have been published in full in the *Biochemical Journal*, by Guha, Hilditch, and Lovern (vol. 24, p. 266; 1930) and by Lovern (*ibid.*, p. 866). The general composition of the fatty acids of cod liver oil is: stearic and myristoleic acids, traces only; myristic acid, 3-7 per cent; palmitic acid,

* The Relative Values of Cod Liver Oils from Various Sources. By Prof. J. C. Drummond and Prof. T. P. Hilditch. (E.M.B. 35.) Pp. 129. (London: H.M. Stationery Office, 1930.) 1*s.* net.

7-13 per cent; palmitoleic acid, 13-20 per cent; oleic and linoleic acids, 18-33 per cent; unsaturated acids containing 20 carbon atoms, 19-32 per cent; unsaturated acids containing 22 carbon atoms, 10-19 per cent. The depth of the yellow colour of the oil was found to be roughly proportional to its vitamin potency.

The variations in potency of different samples are not apparently directly dependent on the age or sexual condition of the fish, but on the character and amount of the food eaten, which varies according to the season. On the other hand, examination of the fish and several crustacea which form the food supply of the cod showed them to be singularly devoid of both vitamins. It has been shown that phytoplankton synthesise vitamin A (Ahmad, *Biochem. Jour.*, vol. 24, p. 860; 1930): zooplankton contain none and neither contain appreciable quantities of vitamin D, although there may be small amounts present in zooplankton. There is no evidence that the cod can synthesise either, though the possibility cannot be excluded. The alternative is that the fish retains the small amounts in its food in its liver, so that over a course of months with a plentiful food supply this organ comes to contain considerable amounts. The potency of the oil varies inversely with the amount obtained from the liver: prior to spawning there is a utilisation of the liver fat, especially in the female; but the vitamin store is not proportionally depleted, so that the oil has a high potency. The authors believe this to be the explanation of the high vitamin content of Newfoundland oil.

From an examination of the effects of different methods of manufacture upon the palatability, keeping properties, and potency of the oil, the following procedure is recommended: Livers should be fresh and steamed immediately they have been removed from the fish. Steam at 60-100 lb. pressure per sq. in. gives better results than steam at a lower pressure, and the process should not be too short. Subsequent refining should be restricted to removal of moisture, debris, and stearine by chilling and centrifuging or pressure; finally, medicinal oils should be stored in vessels impermeable to light and containing as little free air space as possible. Deterioration is caused by the activity of the liver enzymes; hence the necessity for using only fresh material and for adequate steaming to destroy them. High pressure steam also gives a higher yield of oil. It was found that the replacement of air in the storage casks by an inert gas was difficult to carry out properly and did not increase the keeping properties of the oil. Protection from light and undue exposure to air is, however, of great importance.

As a result of their work, the authors put forward the following specifications for medicinal cod liver oil: The colour, when measured in a 1-in. cell, should not be greater than 10 yellow Lovibond units and 0·5 red unit. The free fatty acid (as oleic acid) should not be greater than 0·5 per cent, preferably below 0·3 per cent. The unsaponifiable matter should not be more than 1·5 per cent, preferably below 1 per cent. The vitamin A colour test should give a higher value than 7 blue Lovibond units, when carried out by the authors' technique. For oil intended for farm-stock, the colour and free acidity may be slightly greater but the amount of unsaponifiable matter and vitamin A present should be the same. There appears to be no doubt that oils from Scotland and, especially, Newfoundland are capable of meeting these specifications.

Mosquito Control.*

THE Report for 1930 of the British Mosquito Control Institute, Hayling Island, Hampshire, is a record of two and a half years' work, the previous Report having been presented in June 1928. The Institute, it may be added, was built and equipped in 1925 by Mr. John F. Marshall, who has since occupied the position as director without remuneration. It was incorporated by licence of the Board of Trade in February 1927 and, by a deed executed at the same time, the building and its equipment were leased to trustees for a term of years. No financial aid is received from any official funds, and the income of the Institute is derived solely from the results of its own activities and from subscriptions and donations. Funds are greatly needed in order to enable the work to become more self-supporting, since the present income falls a long way short of covering expenditure.

The activities of the Institute have markedly increased since the issue of the last Report, and the interest shown by the outside public in this work is borne out by the fact that more than 1400 visitors (scientific and others) inspected the museum and laboratory during 1930. Advisory work relating to mosquitoes, their identification and control, is carried out by means of inspection and by correspondence. Inspections are generally undertaken by the director's assistant at a pre-arranged charge which includes the submission of a report and the recommendation of remedial measures. Various lines of investigation have been carried out during the period under review, including tests of fly-killing preparations and of cresol-containing larvicides, at the request of commercial firms. A study has also been commenced with regard to the breeding of arboreal mosquitoes in cavities (natural and artificial) in sawn-off parts of trees of different species.

In June 1929 a special malaria course, arranged in connexion with the League of Nations and the London School of Tropical Medicine, included in its programme a three-day visit to the Institute for laboratory and field instruction. A number of medical officers took part in this work. In September 1930 a week's course, of a tentative character, on mosquito research for university students was given, and was sufficiently appreciated to warrant arrangements being made for its repetition during the present year. Among other educational activities, the director has delivered lectures on mosquito control to various institutions, etc., while demonstrations have been conducted at a number of scientific meetings, exhibitions, etc. By way of technical apparatus, the advances made in connexion with photomicrography and stereograph methods are described in the Report. Mention needs also to be made of the small but growing library of the Institute: a number of new books have been added both by gift and by purchase, while certain of the more important periodicals are taken in regularly. The director of the Institute is to be congratulated upon the initiative and energy he is giving to the development of his charge and on the progress so far achieved.

Scientific societies, educational bodies, local authorities, and other associations desirous of supporting this useful work may become 'collective' members. Members (whether individual or collective) subscribe one guinea per annum and receive a copy of the publications of the Institute.

* British Mosquito Control Institute. Report of the Director. Presented at the Fourth Annual General Meeting, Dec. 9, 1930. 16 pp. and 30 illustrations. Hayling Island, Hampshire.

Grey and Red Squirrels in Britain.

FOR years, naturalists have been familiar in a general way with the aptitude shown by the American grey squirrel for colonising parts of Britain, with the controversy regarding the harmfulness or otherwise of its habits, and the allegation that it has driven the native red squirrel before it. Never before, however, has an attempt at all comparable with that of Mr. A. D. Middleton * been made to collect all the facts regarding this undesirable alien before passing judgment upon it. The paper also contains information relating to the fluctuations and decline of the red squirrel in Great Britain, so important that this species, too, might well have shared a place in the title.

So long ago as 1830, the grey squirrel was known in Montgomeryshire and Denbighshire, but the present state of affairs is almost wholly due to introductions since 1890. Thirty-three different introductions, involving twenty-nine localities, have been traced, and the sum of their results is astonishing. By 1930 the grey squirrel, according to Mr. Middleton's thorough census, had populated a total area of approximately 13,350 square miles, mainly in southern England, Cheshire, and Yorkshire, and there is every reason to believe that it will eventually cover the whole country, with the possible exception of mountainous districts such as northern Scotland.

Although much of the evidence regarding the food of the creature is unbalanced or biased, there can be little doubt that it is a nuisance in Great Britain. Green food, fruit, and nuts form the major part of the food supply, but it robs birds' nests of their eggs and young, and the damage it does to woodland by biting off young shoots and leaders, and by peeling or ringing the bark of young trees (the present writer has seen branches of old trees girdled as well), is enough to condemn it in the eyes of every forester. The fact that at least 750,000 acres of new forest are in progress of being planted suggests that here lies a potential food-store to encourage fresh colonisation, and points to a new danger in the presence of the grey squirrel.

It has often been said that the grey squirrel kills out or drives away the native red squirrel, but no direct evidence of such antagonism has been forthcoming. The present writer agrees entirely with Mr. Middleton's view that in many areas (in Scotland, at any rate) the red squirrel has declined, apart altogether from the presence of its possible rival. Nevertheless, the red squirrel almost holds its own in some of the extensive northern forests, and it must surprise many readers to learn that the Highland Squirrel Club, in a limited area confined to thirty-six estates in the north of Scotland, destroyed in the years from 1903 to 1929, 82,000 squirrels.

In considering the future possibilities of the introduced grey squirrel as a serious economic pest, it is well to remember that, so far as Scotland is concerned, the red squirrel itself is a species that was reintroduced after it had almost or wholly disappeared, about the beginning of the nineteenth century. One would imagine that the tale of the risk of introductions was written plain enough for anyone to see, and yet the process goes merrily on: within the last few years the musk-rat has been added to the Scottish list of aliens likely to call down future curses upon the heads of its thoughtless or ignorant sponsors.

J. R.

* A. D. Middleton, "The Ecology of the American Grey Squirrel (*Sciurus carolinensis*) in the British Isles", *Proc. Zool. Soc. London*, part 3, p. 809; 1930.

Birthdays and Research Centres.

April 2, 1853.—Prof. P. PHILLIPS BEDSON, emeritus professor of chemistry, Armstrong College, Newcastle-on-Tyne.

In describing some experiments on the gases enclosed in certain varieties of coal dust, at a meeting of the North of England Institute of Mining and Mechanical Engineers in 1888, I directed attention to the fact that the inflammable constituent appeared to contain other members of the paraffin series in addition to methane (marsh gas). In the discussion, the late Sir Charles Parsons suggested that the examination of the gases released from the coal yielding such dust, by grinding it in a vacuum, might afford information on the composition of these gases. In the session 1913–14, I had contrived a method of testing this suggestion, but was unable to complete the investigation, as on the outbreak of War the buildings of Armstrong College were taken over by the military authorities, and when possession was regained in 1919 opportunity for pursuing the investigations further did not present itself. In 1921, I resigned from the professorship of chemistry in Armstrong College and came to reside in the south of England. The repetition of this work, in the light of the influence of these gases on the ignitability of mixtures of air and coal dust, and the examination of firedamp for the presence of other paraffin hydrocarbons than methane, is a problem to which attention might usefully be given.

April 5, 1865.—Sir JOHN BRETLAND FARMER, F.R.S., emeritus professor of botany and formerly director of biological laboratories, Imperial College of Science and Technology, London.

Amongst the various lines of research in which I happen to have been specially interested, there are few, I think, which offer more attractive possibilities than those which concern excretion, in the larger sense of the term. The mechanism by which sugar in a concentrated state is excreted in nectaries (and by various other non-floral glands), though doubtless not too easy to investigate, is one which can surely yield a much larger harvest on the way towards its solution than it has yet produced. Of course, it may be said that the whole matter is a question of energy—and this observation was actually made to me by a very eminent physiologist of his day, some twenty years ago. But it is clear that very little is thereby really gained. No doubt the energy for moving a train is derived from the combustion of coal in the engine, but that tells nothing of the *machinery* and of the steps whereby the energy derived from oxidation of coal is enabled to be utilised for moving the train.

A set of problems akin—perhaps more than is at first sight obvious—to those just referred to, concern the internal movement of water within the higher plant, wherever protoplasm takes a hand in the matter. Much has from time to time been written about 'root pressure', but how much is really *known* as to the *Wesen* of root pressure? It is a subject I have myself pursued, not too successfully, for a number of years, though I did find a few side tracks which seemed to be more hopeful than the main route. It would be useful to know to what extent and under what precise conditions the sugars derived from the surrounding living parenchymatous cells find their way into the dead wood vessels. Semi-permeability has really ceased to be a rigorous dogma where living protoplasm is concerned. It is another example of the truth that 'circumstances alter

cases'. By that same track we get into closer touch with the problems of spring bleeding so characteristic of many trees, etc., though in different degrees, and varying under different external conditions.

In concluding the few remarks, which have filled more than the space allotted to me, may I venture to suggest that many of our younger botanists, particularly those who are physiologically-minded, might profitably acquire a larger horticultural knowledge of growing plants than most of them seem to possess? The problems of the garden are numerous and profitable, but a practical fore-knowledge of the garden and its denizens is essential for their recognition; the garden is a more fertile source of inspiration and research than many shelves of 'pickle' bottles.

April 5, 1868.—R. H. BURNE, F.R.S., physiological curator at the Royal College of Surgeons, London.

During the past few years I have been much interested in certain peculiarities of the lymphatic system of Teleostean fishes, which suggest that in the early stages of its differentiation the lymphatic system comprised both afferent and efferent factors comparable to arteries and veins. I am now carrying on similar researches into the constitution of the pseudo-lymph system in the skin of Elasmobranchs, in the hope of determining the nature of the 'cutaneous veins' and their morphological relationship to the rest of the vascular system and to the cutaneous lymphatics of other fishes.

April 11, 1890.—Prof. E. K. RIDEAL, F.R.S., professor of colloid physics in the University of Cambridge.

We are engaged in determining the potential difference existing at air-liquid interfaces and also at gas-metal interfaces. This potential difference is modified to a marked extent by the presence of a unimolecular film, for example, a fatty acid film on a water surface or alcohol on a gold surface. These changes caused by films of different types, of different surface concentrations, of films undergoing chemical reaction or simple solution or evaporation, can be measured with considerable accuracy.

Societies and Academies.

LONDON.

Institute of Metals (Annual General Meeting), Mar. 12.—**C. E. Pearson and J. A. Smythe**: The influence of pressure and temperature on the extrusion of metals. The paper describes experiments made in a small press on the extrusion-phenomena of the metals lead, cadmium, bismuth, and tin. The chief part of the work is concerned with the determination, under precise control, of the relationship between the rate of extrusion, pressure, and temperature. This relationship is expressed in a series of curves, the mathematical treatment of which is indicated.—**J. D. Grogan and D. Clayton**: Dimensional stability of heat-treated aluminium alloys. Careful search has failed to reveal the occurrence of secular change in certain commercial heat-treated aluminium alloys, subsequent to the completion of the normal ageing process. Serious dimensional changes occur when machining operations are carried out on material quenched in cold water.—**D. Hanson and M. A. Wheeler**: The deformation of metals under prolonged loading. (1) The flow and fracture of aluminium. The principal method used consisted in examining the changes in microstructure of polished specimens, subjected to static stresses at room and elevated temperatures. The extension under a prolonged load that will ultimately break the metal may be considered as consisting of a period of primary extension, during which the rate of flow diminishes; a period during which flow is very slow or even suspended; and a period during which the extension again increases continuously until fracture occurs. Failure under creep conditions may be due to intercrystalline cracking, resumption of slipping within the original crystals, or recrystallisation. Failure of aluminium under various conditions was examined. Rupture of the crystals probably commences along slip planes formed at an early stage in the deformation of the metal.—**K. L. Meissner**: The effect of artificial ageing upon the resistance of super-duralumin to corrosion by sea-water. A different 'pock-form corrosion', combined with highly deleterious effect on the tensile properties, and primarily caused by intercrystalline corrosion, was found in an intermediate range of annealing temperature at 125°-145° C., and especially at 140° C.—**S. L. Archbutt and W. E. Prytherch**: Investigation of the effects of impurities on copper. (7) The effect of antimony on copper.—(8) The combined effect of antimony and arsenic on copper. In the antimony copper series, alloys containing up to 0·85 per cent antimony have been studied, and in the arsenic-antimony-copper series, up to 0·5 per cent of each impurity together. In the former series, alloys containing up to 0·47 per cent antimony withstood hot rolling and up to 0·85 per cent cold rolling from cast billets. An alloy containing 0·85 per cent antimony was hot short. In the latter series all compositions withstood rolling either hot or cold. Antimony is highly soluble in solid copper, and small additions of this element to copper low in oxygen are found to improve the tensile strength at ordinary temperatures and at 250° C. the fatigue properties, and to raise the softening temperature (of cold-worked material), without impairing ductility or toughness. Copper low in oxygen, containing antimony and arsenic together, appears to withstand hot rolling better than with antimony alone. The mechanical properties of copper low in oxygen are improved by small additions of antimony and arsenic together. Both impurities lower the electrical conductivity of copper. **L. J. Brice**: Some properties of silicon-'aluminium-bronzes'. The paper describes the results of a detailed study of the Brinell hardness, mechanical properties, and microstructure of three typical aluminium-copper alloys, containing respectively 5·0, 7·25, and 10·0 per cent aluminium, with the addition to each of up to 5·0 per cent silicon.—**Owen W. Ellis**: The rolling of alloys of copper and phosphorus containing up to 5 per cent of phosphorus. The plain phosphorus-copper alloys can all be successfully hot-rolled at 450°-650° C. to produce strip 0·021 in. thick, provided that only small reductions of thickness are made at each stage of the rolling. In this way the copper-copper phosphide eutectic structure is thoroughly broken up, and the strip can then be cold-rolled to 0·015 in.

PARIS.

Academy of Sciences, Feb. 16.—**Jean Rey**: The conditions for the best utilisation of the energy of warm water, natural and industrial.—**Georges Claude**: Remarks on the preceding communication.—**E. Mathias**: The destructive effects of lightning upon plants. A discussion of the cause of the observed fact that when a single tree is struck by lightning and killed, and the lesions on the tree are obvious, plants and trees within a certain radius of this tree also die, although there are no lesions to account for this.—**Edmond Sergent, A. Donatien, L. Parrot, and F. Lestoquard**: Etiological considerations on north

African bovine theilerosis. Nine-tenths of the cases occur between June 15 and Aug. 31 in each year. This is explained by a study of the life-histories of the micro-organism *Theileria dispar* and the transmitting tic, *Hyalomma mauritanicum*.—Paul Pelseneer was elected *correspondant* for the Section of Anatomy and Zoology, in succession to the late A. Brachet.—**Potonniée**: The discovery in Russia of unpublished letters of Nicéphore Niepce, the inventor of photography.—**J. Doubnoff**: The fundamental tensors of a rectilinear congruence.—**Mlle. Marie Charpentier**: The Peano points of the equations $y' = f$ for which the unicity of the solution is assured of one side.—**Georges Bouligand**: The commencing movement of a liquid mass.—**Benjamin Jekhowsky**: Exact and simple formula for the identification of the minor planets.—**J. Dourgnon and P. Waguet**: The photometric properties of rough diffusing surfaces.—**R. Zouckermann**: High frequency discharges in nitrogen in the presence of mercury.—**G. A. Boutry**: The characteristic surface $i = f(F. V)$ of a photoelectric cell with a gaseous atmosphere.—**E. L. Harrington**: The nature of the radioactive groupings of atoms. Although it is probable that groupings round impurities as nuclei may take place, it is doubtful whether the presence of impurities is the essential factor. The nucleus may be a particle of an impurity, but is generally a stable association of ionised radioactive atoms.—**Mme. Mathieu, Mathieu, and Paic**: Some reactions produced in the solid state. A list of chemical reactions between two solid substances is given. It is suggested that reactions produced by grinding in a mortar would be those in which the molecular volume of the system would be reduced by a reaction; but this does not appear to be the case, with the examples given.—**H. Muraour and G. Aunis**: The laws of combustion of colloidal powders (explosives) containing vaseline.—**E. Rinck**: An allotropic transformation of calcium in the solid state. Experiments are described, proving the existence of two allotropic varieties of the metal calcium, the transformation point being 450° C.—**E. Carrière and Raulet**: Contribution to the study of the sodium silver hyposulphite complexes.—**L. Hackspill and J. Weiss**: The hypophosphites of cæsium and of rubidium. The properties of cæsium and rubidium hypophosphites resemble those of the other alkaline hypophosphites. Their density increases in the same sense as their atomic weight, and the decomposition on heating is similar to that of the other alkaline salts.—**Mme. Ramart-Lucas and Mme. Bruzau**: Absorption and reactivity of the ketone function. Arguments against the theory of steric hindrance, with special reference to the case of the hexalkylacetones. It appears possible to explain the variations in the chemical activity of the ketonic group by a mutual influence between the alkyl radicals present in the molecule without steric hindrance intervening.—**A. Mailhe and Renaudie**: The transformation of the butylenes into liquid hydrocarbons. Study of the catalytic action of silica at 650°-700° C. on the butylenes.—**Léon Moret**: Discovery of the Purbeckian in the Semnoz Chain, near Annecy (Haute-Savoie).—**V. Perebaskine**: Observations on the geology of the Gabon.—**Roger Heim**: The spore in the genus *Inocybe*.—**St. Jonesco**: The formation of anthocyanic pigments in the etiolated shoots of buck-wheat and of wheat.—**E. Michel-Durand**: The influence of light on the migration of nutritive material at the moment of bursting of buds.—**A. Brunel**: The presence of allantoinase in many fungi. The ferment is recognised by its converting allantoin into allantoic acid: a list of 66 fungi containing allantoinase is given.—**Mme. L. Randoin and R. Lecoq**: Constitution of a new food regime for the study of B avitaminoses, containing reduced proportions of glucides but rich in lipides.—**A. and R. Sartory and J. Meyer**: Phenomena resulting from the irradiation of the cutaneous tissue and of the male genital gland of the rabbit as a function of the mode of application of the radiation.—**Raymond-Hamet**: The pharmacological influence of the substitution of a methyl group on the β carbon of the methylamino-paraoxyphenyl-carbinol.—**Jean Saidman, Roger Cahen, and Jacques Forestier**: The action of electric fields of very high frequency on organic tissues. Description of the technique found best for human subjects.—**J. Verge and M. Vallée**: The treatment of diarrhœa of calves by the bacteriophage. The specific bacteriophage has been isolated from the intestine of convalescent subjects and subjected to further laboratory treatment. Accounts of various cases in which the treatment was beneficial are given.

ROME.

Royal National Academy of the Lincei: Communications received during the vacation, 1930.—**U. Cisotti**: Hemisotropic quintuple tensors.—**M. La Rosa and G. Petrucci**: A circuit emitting trains of discontinuous waves.—**G. Mammana**: A fundamental theorem of mathematical analysis. Treatises on the calculus deal with a theorem of reduction of a multiple series or one of inversion, a theorem of integration and derivation by series, a theorem of reduction of total derivative, one of inversion of the order of derivation, etc., as so many detached propositions. All these theorems and, in general, all those leading to reduction or inversion of limits are immediate corollaries of a single theorem, and an attempt is now made to establish this with the maximum possible generality.—**Maria Nasta**: Contribution to the calculation of the critical velocity of motor shafts.—**Bice Pelini**: Table of the potential of a magnetic lamina with a circular rim. A description is given of the method of compiling a table to show, for various points in space and with an error less than 1 in 1000, the potential of a magnetic lamina with a circular rim and with unit intensity of magnetisation.—**G. Krall**: Problems of the dynamics of the binary.—**E. Segrè**: The Raman effect of acetylene. An apparatus for the study of the Raman effect in gases in the visible spectrum is described, and the results obtained with acetylene are given.—**D. Graffi**: Considerations on the theory of the transmission of heat by forced convection.—**A. Baroni**: Methylselenomercaptan. This compound, $CH_3.SeH$, obtained by treating an alcoholic solution of sodium hydroselenide with methyl iodide, is an almost colourless liquid of persistent, unpleasant odour and boils at 12° C. The mercury, lead, silver, copper, and bismuth derivatives are described.—**Giovanni Sani**: Investigations on oleastene, a hydrocarbon contained in the fruit of the olive. The formula of this hydrocarbon is at least C_7H_{12} and is probably $C_{21}H_{36}$.—**G. Mezzadroli and E. Vareton**: Action of ultra-short magnetic waves (λ2-3 metres) on silk-worms. The best procedure to be followed, in applying these waves to silk-worms, is described. The weight of the cocoons formed by the irradiated worms is greater by 19 per cent than that of the cocoons from the controls.—**M. Mitolo**: The moderating power of the central nervous tissue. This tissue is endowed with a moderating power which is of a physico-chemical character and is probably due to certain acid-salt systems (phosphoric acid-phosphates, carbonic acid-carbonates, etc.) with an equilibrium near the neutral point and with low dissociation constants, rather than to proteinates.—**L. Bracaloni**: Normal hydræmic curve (on fasting) during various physical exertions of short duration.—**Clara Forti**: Excision of the vessels and nerves of the ovary: Historical notices (1).

Official Publications Received.

BRITISH.

Committee of the Privy Council for Medical Research. Report of the Medical Research Council for the Year 1929–1930. (Cmd. 3785.) Pp. 138. (London: H.M. Stationery Office.) 2s. 6d. net.

Researches published from the Wards and Laboratories of the London Hospital during 1930. 38 papers. (London: H. K. Lewis and Co., Ltd.) 7s. 6d. net.

Reports of the Progress of Applied Chemistry. Issued by the Society of Chemical Industry. Vol. 15, 1930. Pp. 758. (London.) 7s. 6d. to Members; 12s. 6d. to others.

Dominion Bureau of Statistics. Canada, 1931: an Official Handbook of Present Conditions and Recent Progress. Pp. vii + 199. (Ottawa: Dominion Bureau of Statistics; London: High Commissioner for Canada.) 25 cents.

Transactions of the Institute of Marine Engineers, Incorporated. Session 1931, Vol. 43, No. 1, February. Pp. 56+xliv. (London.)

The National Institute of Industrial Psychology. Annual Report and Statement of Accounts for the Year ended December 31st, 1930. Pp. 36. (London.)

The Proceedings of the Physical Society. Vol. 43, Part 2, No. 237, March 1. Pp. viii+119-226. (London.) 7s. net.

Proceedings of the Royal Society. Series A, Vol. 130, No. A815, March 3. Pp. 551-697+xxxiv. (London: Harrison and Sons, Ltd.) 8s.

Mysore Geological Department. Records, Vol. 26, 1927. Pp. iii+28. (Bangalore: Government Press.) 2 rupees.

Education, Simla. Education in India in 1928-29. Pp. iv+74. (Calcutta: Government of India Central Publication Branch.) 14 annas; 1s. 6d.

The Journal of the Royal Technical College. Vol. 2, Part 3, January. Pp. iv+371-566. (Glasgow: Robert Anderson and Sons, Ltd.) 10s. 6d.

Allahabad University Studies. Vol. 5. Pp. v+495. 7.8 rupees. Vol. 6, Part 1 (Arts, Law and Commerce). Pp. iv+883. 7.8 rupees. Vol. 6, Part 2 (Science Section). Pp. v+257. 7.8 rupees. (Allahabad.)

British Mosquito Control Institute. Report of the Director, presented at the Fourth Annual General Meeting held in the Rooms of the Entomological Society of London on the 9th December 1930. Pp. 16+15 plates. (Hayling Island.)

The Quarterly Journal of the Geological Society of London. No. 345, Vol. 87, Part 1, February 28th. Pp. 179. (London: Longmans, Green and Co., Ltd.) 7s. 6d.

The Association of Women Science Teachers. Report for 1930, and List of Members. Pp. 52. (London.)

The Journal of the Quekett Microscopical Club. Edited by W. S. Warton. Ser. 2, Vol. 16, No. 97, March. Pp. 151-215. (London: Williams and Norgate, Ltd.) 5s. net.

Tanganyika Territory: Geological Survey Department. Annual Report, 1929. By Dr. E. O. Teale. Pp. iii+60+6 plates. (Dar es Salaam: Government Printer.) 4s.

University of Leeds. Twenty-sixth Report, 1929–30. Pp. 174. Publications and Abstracts of Theses by Members of the University during Session 1929–30. Pp. 54. (Leeds.)

Proceedings of the Royal Irish Academy. Vol. 40, Section B, No. 1: Irish Sea-Trout; Notes on Collections of Scales from the West Coast of Ireland. By G. Herbert Nall. Pp. 36+3 plates. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 1s. 6d.

The Scientific Proceedings of the Royal Dublin Society. Vol. 19 (N.S.), No. 39: Some Geochemical Applications of Measurements of Hydrogen Ion Concentration. By Dr. W. R. G. Atkins. Pp. 455-460. 6d. Vol. 19 (N.S.), No. 45: Photo-electric Measurements of Illumination in relation to Plant Distribution. Part 3: Certain Spruce, Larch, Oak and Holm Oak Woods. By Dr. W. R. G. Atkins and Florence A. Stanbury. Pp. 517-531. 1s. Vol. 19 (N.S.), No. 46: The Distribution of Pasture Plants in relation to Soil Acidity and other Facts. By Dr. W. R. G. Atkins and E. Wyllie Fenton. Pp. 533-547. 1s. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.)

Armstrong College, Newcastle-upon-Tyne: Standing Committee for Research. Report, Session 1929–1930. Pp. 31. (Newcastle-upon-Tyne.)

Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1342 (Ae. 474—T. 2985): Airscrews for High Speed Aeroplanes. By H. Glauert. Pp. 18+6 plates. 1s. net. No. 1348 (Ae. 480—T. 2994): On the Validity of Large Scale Tests in an Open Jet Wind Tunnel—Tests on one-fifth Scale Bristol Fighter (7·9 ft. Span) in 5 ft. Open Jet Tunnel. By W. G. A. Perring and C. Callon. 9d. net. (London: H.M. Stationery Office.)

The Polar Record. No. 1, January. Pp. 35. (Cambridge: At the University Press.) 1s.

Journal of the Society of Glass Technology. Edited by Prof. W. E. S. Turner. Vol. 14, No. 56, December 1930. Pp. xii+131-212+307-424+315-511+xxvii. (Sheffield.) 10s. 6d.

The Ninety-seventh Annual Report of the Royal Cornwall Polytechnic Society. New Series, Vol. 6, Part 4, 1930. Pp. xliii-lii+313-425+viii+14. (Camborne.) 5s.

Sydney University Reprints. Series 3 (Chemistry, Organic and Inorganic). Vol. 1, Nos. 45-61. 17 papers. Series 9 (Medical Sciences, Non-clinical). Vol. 2, Nos. 13-38. 26 papers. (Sydney, N.S.W.)

Memoirs of the Geological Survey of India. Palæontologia Indica. New Series, Vol. 17: New Fossils from the Productus Limestones of the Salt Range, with Notes on other Species. By Dr. F. R. C. Reed. Pp. v+56+8 plates. (Calcutta: Government of India Central Publication Branch.) 5.6 rupees; 8s. 9d.

Liverpool Observatory and Tidal Institute. Annual Report 1930. Pp. 18. (Liverpool.)

The Half-Yearly Journal of the Mysore University. Vol. 4, No. 2, July, 1930. Pp. 145-261. (Bangalore.) 2 rupees.

Annals of the Natal Museum. Edited by Dr. Ernest Warren. Vol. 6, Part 3, February. Pp. 337-506+plates 23-38. (London: Adlard and Son, Ltd.) 19s. net.

Proceedings of the Malacological Society of London. Edited by R. Winckworth. Vol. 19, Part 4, March. Pp. 155-218+plates 18-25. (London: Dulau and Co., Ltd.) 10s. net.

Report of the British Museum Expedition to British Honduras, 1930. By Capt. E. L. Gruning. (Reprinted from the *Journal of the Royal Anthropological Institute*, Vol. 60, July–December 1930.) Pp. 477-483+plates 16-22. (London: Royal Anthropological Institute.) 1s.

Proceedings of the Prehistoric Society of East Anglia for 1930. Vol. 6, Part 3. Edited by G. Maynard. Pp. xii+147-251+plates 12-19. (London: H. K. Lewis and Co., Ltd.; Geo. Salby.) 20s. net.

Proceedings of the Society for Psychical Research. Part 120, Vol. 40, February; Library Catalogue (Supplement 1929–1930). Pp. 58. (London.) 1s. 6d.

The Journal of the Board of Greenkeeping Research. Vol. 2, No. 4, March. Pp. 88+xxxi+8 plates. (Bingley: St. Ives Research Station.) 2s. 6d.

The Journal of the Institution of Electrical Engineers. Edited by P. F. Rowell. Vol. 69, No. 411, March. Pp. 325-444+xxvi. (London: E. and F. N. Spon, Ltd.) 10s. 6d.

The British Mycological Society Transactions. Edited by Carleton Rea and J. Ramsbottom. Vol. 15, Parts 3 and 4, March 21. Pp. 193-378. (London: Cambridge University Press.) 15s.

Papers from the Geological Department, Glasgow University. Vol. 13 (Octavo Papers of 1928–1930). (Glasgow University Publications, 20.) Pp. viii+20 papers. (Glasgow: Jackson, Wylie and Co.)

The Journal of the Royal Anthropological Institute of Great Britain and Ireland. Vol. 60, July to December 1930. Pp. ix+269-558+plates 4-22. (London.) 15s. net.

Medical Research Council. Tenth Annual Report of the Industrial Health Research Board (formerly the Industrial Fatigue Research Board) to 31st December 1929. Pp. 29. (London: H.M. Stationery Office.) 6d. net.

Transactions of the Royal Society of Edinburgh. Vol. 56, Part 3, No. 28: The Stem-Endodermis in the Genus Piper. By Dr. George Bond. Pp. 695-724+3 plates. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.) 5s.

FOREIGN.

The Science Reports of the Tôhoku Imperial University, Sendai, Japan. First Series (Mathematics, Physics, Chemistry), Vol. 19, No. 5. Pp. 473-680. Fourth Series (Biology), Vol. 5, No. 4. Pp. 615-837. (Tokyo and Sendai: Maruzen Co., Ltd.)

Columbia University Bulletin of Information. 31st Series, No. 17: Announcement of Professional Courses in Optometry for the Winter and Spring Sessions, 1931–1932. Pp. 31. (New York City.)

United States Department of the Interior: Geological Survey. Bulletin 821-B: A Geologic Study of the Madden Dam Project, Alhajuela, Canal Zone. By Frank Reeves and Clyde P. Ross. (Contributions to Economic Geology, 1930.) Pp. iv+11-49+plates 4-13. 40 cents. Water-Supply Paper 622: Surface Water Supply of the United States, 1926. Part 2: South Atlantic Slope and Eastern Gulf of Mexico Basins. Pp. iv+118. 20 cents. Water-Supply Paper 644: Surface Water Supply of the United States, 1927. Part 4: St. Lawrence River Basin. Pp. v+156. 25 cents. Water-Supply Paper 649: Surface Water Supply of the United States, 1927. Part 9: Colorado River Basin. Pp. v+99. 20 cents. Water-Supply Paper 650: Surface Water Supply of the United States, 1927. Part 10: The Great Basin. Pp. v+97. 20 cents. (Washington, D.C.: Government Printing Office.)

Contributions from the Jefferson Physical Laboratory and from the Cruft High-Tension Electrical Laboratory of Harvard University for the Years 1928 and 1929. Vol. 20. 62 papers. (Cambridge, Mass.)

Bernice P. Bishop Museum. Bulletin 74: New Plants from Fiji, I. By John Wynn Gillespie. Pp. 99. Bulletin 75: Samoan Material Culture. By Te Rangi Hiroa (P. H. Buck). Pp. xi+724+56 plates. Bulletin 77: Hawaiian Proverbs and Riddles. By Henry P. Judd. Pp. 91. Bulletin 78: Report of the Director for 1929. By Herbert E. Gregory. Pp. 40. Special Publication 16: Proceedings, Hawaiian Academy of Science, Fifth Annual Meeting, May 1-3, 1930. Pp. 19. Memoirs, Vol. 11, No. 4: The Physical Characters of the Society Islanders. By H. L. Shapiro. Pp. 39+4 plates. Occasional Papers, Vol. 9, No. 1: Geology of Molokini. By Harold S. Palmer; with Notes on the Flora of Molokini, by Edward L. Caum. Pp. 18. Occasional Papers, Vol. 9, No. 2: Notes on Polynesian Pounders. By L. J. Bouge. Pp. 11. Occasional Papers, Vol. 9, No. 3: New Hawaiian Species of Pipturus. By Vladimir Krajima. Pp. 6. Occasional Papers, Vol. 9, No. 4: New Polynesian Plants. By Forest B. H. Brown. Pp. 23. Occasional Papers, Vol. 9, No. 5: New Hawaiian Plants. By Edward L. Caum. Pp. 30. Occasional Papers, Vol. 9, No. 6: New Hawaiian Medusae. By Charles Howard Edmondson. Pp. 16. Occasional Papers, Vol. 9, No. 7: Effect of Ultraviolet Rays in Regeneration of Chelipeds. By Charles Howard Edmondson. Pp. 7. Occasional Papers, Vol. 9, No. 8: The Problem of Polynesian Origins. By E. S. Craighill Handy. Pp. 27. Occasional Papers, Vol. 9, No. 9: Notes on Tongan Ethnology. By J. D. Whitcombe. Pp. 20. Occasional Papers, Vol. 9, No. 10: New Hawaiian Crustacea. By Charles Howard Edmondson. Pp. 18. Occasional Papers, Vol. 19, No. 11: New Species of Partula. By C. Montague Cooke, Jr., and Henry E. Crampton. Pp. 9. (Honolulu.)

Evidence on the Nature of the Elementary Magnet from Researches on Gyromagnetic Phenomena. Faculty Research Lecture at the University of California at Los Angeles, delivered April 20, 1928, by Prof. S. J. Barnett. Pp. 43. (Los Angeles, Cal.)

Smithsonian Miscellaneous Collections. Vol. 82, No. 10: Morphology of the Bark-Beetles of the Genus *Gnathotrichus* Eichh. By Karl E. Schedl. (Publication 3063.) Pp. 88. (Washington, D.C.: Smithsonian Institution.)

Publikace Pražské Státni Hvězdárny (Publications de l'Observatoire National de Prague.) No. 7: Sur la théorie ellipsoidale de Schwarzschild. Par Dr. V. Nechvíle. Pp. 15. (Prague.)

Proceedings of the Imperial Academy. Vol. 6, No. 10, December. Pp. xxix-xxx+385-430. (Tokyo.)

Proceedings of the Academy of Natural Sciences of Philadelphia. Vol. 82. The Orthoptera of Alberta. By Morgan Hebard. Pp. 377-403. The Land Snail Genus Haplotrema. By H. Burrington Baker. Pp. 405-425. (Philadelphia.)

Proceedings of the American Philosophical Society. Vol. 69. No. 8. Pp. xix+529-580. (Philadelphia.)

United States Department of Agriculture. Circular No. 129: Survey of the Fertilizer Industry. By P. E. Howard. Pp. 23. 5 cents. Technical Bulletin No. 228: Character of the Colloidal Materials in the Profiles of certain Major Soil Groups. By M. S. Anderson and Horace G. Byers. Pp. 24. 5 cents. Farmers' Bulletin No. 1654: Insects of the Pecan and how to Combat Them. By G. F. Moznette, T. L. Russell and H. S. Adair. Pp. ii+60. 15 cents. Leaflet No. 65: Red-Squill Powder in Rat Control. By James Silver and J. C. Munch. Pp. 8. 5 cents. Technical Bulletin No. 229: Variations of the Colloidal Material extracted from the Soils of the Miami, Chester and Cecil Series. By R. S. Holmes and Glen Edgington. Pp. 24. 5 cents. (Washington, D.C.: Government Printing Office.)

Statens Meteorologisk-Hydrografiska Anstalt. Årsbok, 10, 1928. iii: Vatten ståndet vid Rikets kuster. Pp. 22. 2.00 kr. Årsbok, 11, 1929. v: Hydrografiska mätningar i Sverige. Pp. 18+4 planscherna. 3.00 kr. Årsbok, 11, 1929. vi: Aerologiska iakttagelser i Sverige. Pp. 40. 3.00 kr. Meddelanden, Band 6, No. 1: Norrskensfotogrammetri i Abisko under Februari och Mars 1922. Av Hjalmar Hammarén. Pp. 17+9 planscherna. 2.50 kr. Meddelanden, Band 6, No. 2: Vegetationens utveckling i Götaland. Av Knut Arnell och Sigfrid Arnell. Pp. 70. 3.50 kr. (Stockholm.)

U.S. Department of Commerce: Bureau of Standards. Research Paper No. 235: Efficiency of Production of X Rays. By Warren W. Nicholas. Pp. 843-865. 10 cents. Bureau of Standards Journal of Research. Vol. 6, No. 1, January. Pp. 182. (Washington, D.C.: Government Printing Office.)

New York State College of Home Economics at Cornell University, Ithaca, New York. Fifth Annual Report, 1930. Pp. 103. (Ithaca, N.Y.)

Cornell University Agricultural Experiment Station. Bulletin 513: The Chemical Composition of New York Soils. By J. A. Bizzell. Pp. 25. Bulletin 514: Soil and Field-Crop Management for Chenango County, New York. By A. F. Gustafson, H. O. Buckman and H. P. Cooper. Pp. 81. Memoir 134: Lysimeter Experiments. 3: Records for Tanks 3 to 12 during the Years 1910 to 1924 inclusive. By T. L. Lyon, J. A. Bizzell, B. D. Wilson and E. W. Leland. Pp. 72. (Ithaca, N.Y.)

Proceedings of the California Academy of Sciences, Fourth Series. Vol. 19, No. 12: Pelagic Mammals from the Temblor Formation of the Kern River Region, California. By Remington Kellogg. Pp. 217-397. (San Francisco.) 1.25 dollars.

Annales de l'Institut de Physique du Globe de l'Université de Paris et du Bureau central de Magnétisme terrestre. Publiées par les soins de Prof. Ch. Maurain. Tome 8. Pp. iv+149. (Paris: Les Presses universitaires de France.)

Comité National Français de Géodésie et de Géophysique: Section de Magnétisme et Electricité terrestres. Nouveau réseau magnétique de la France au 1er janvier 1924. Mémoire 2: Distribution générale des éléments magnétiques en France, formules représentatives, définition numérique des anomalies. Par E. Mathias, Ch. Maurain et L. Eblé. (Extrait des Annales de l'Institut de Physique du Globe de l'Université de Paris, Tome 8, 1930.) Pp. 37-62. (Paris: Les Presses universitaires de France.)

Conseil Permanent International pour l'Exploration de la Mer. Rapports et Procès-verbaux des réunions. Vol. 70: Rapport atlantique 1929 (Travaux du Comité du Plateau continental atlantique). Publié avec l'aide de Dr. Ed. Le Danois et Rafaël De Buen. Pp. 126. (Copenhague: Andr. Fred. Høst et fils.) 5.00 kr.

University of Illinois Engineering Experiment Station. Bulletin No. 217: Washability Tests of Illinois Coals. Conducted by the Engineering Experiment Station, University of Illinois, in coöperation with the Zeigler Coal and Coke Company. By Prof. Alfred C. Callen and David R. Mitchell. Pp. 114. 60 cents. Bulletin No. 218: The Friability of Illinois Coals. By Cloyde M. Smith. Pp. 22. 15 cents. (Urbana, Ill.)

Bulletin of the National Research Council. No. 81: Industrial Research Laboratories of the United States, including Consulting Research Laboratories. Fourth edition, revised and enlarged. Compiled by Clarence J. West and Callie Hill. Pp. 267. (Washington, D.C.: National Academy of Sciences.)

Carnegie Institution of Washington. Annual Report of the Director of the Department of Terrestrial Magnetism. (Reprinted from Year Book No. 29, for the Year 1929-30.) Pp. 249-322. (Washington, D.C.: Carnegie Institution.)

Proceedings of the United States National Museum. Vol. 78, Art. 15: Notes on some Acalyptrate Flies in the United States National Museum. By John R. Malloch. (No. 2858.) Pp. 32. (Washington, D.C.: Government Printing Office.)

Meddelande från Lunds Observatorium. No. 124: Über die Bestimmung der Fehler von Mikrometerschrauben. Von John Ohlsson. Pp. 4. No. 125: Über die Bestimmung der Entfernungen, Dimensionen, Massen und Dichtigkeiten für die nächstgelegenen anagalaktischen Sternsysteme. Von Knut Lundmark. Pp. 13. (Lund.)

U.S. Department of Commerce: Coast and Geodetic Survey. Special Publication 170: Chart Datums. By H. A. Marmer. Pp. ii+49. (Washington, D.C.: Government Printing Office.) 10 cents.

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 104: The Operation of the Seed Control Law upon the Pedigree of Cotton Seed in Season 1926 to 1930, with a Discussion of Evasions of the Law. By Dr. W. Lawrence Balls and Armenag Eff. Bedevian. Pp. 28+23 plates. (Cairo: Government Press.) 10 P.T.

The Science Reports of the Tôhoku Imperial University, Sendai, Japan. First Series (Mathematics, Physics, Chemistry), Vol. 19, No. 6, December. Pp. 681-800. (Tokyo and Sendai: Maruzen Co. Ltd.)

U.S. Department of Agriculture. Farmers' Bulletin No. 1623: The Gipsy Moth and the Brown-Tail Moth. By A. F. Burgess. Pp. 33. (Washington, D.C.: Government Printing Office.) 10 cents.

Scientific Papers of the Institute of Physical and Chemical Research. Nos. 283-285: Fat Soluble Vitamins in Tumor Tissues, by Midzuho Sumi and Waro Nakahara; Über die Einwirkung der Kalilange auf die Tetracarbonsäureester von Dimalonsäure-Reihe. (Darstellung von Aethyl-Phenylpropionsäuren), von Hsiung Tsai Lo; A new Radio-active Mineral found in Japan, by Satoyasu Iimori, Jun Yoshimura and Shin Hata. Pp. 69-88+4 plates. (Tôkyô: Iwanami Shoten.) 45 sen.

Smithsonian Miscellaneous Collections. Vol. 85, No. 1: Weather dominated by Solar Changes. By C. G. Abbot. Hodgkins Fund and Roebling Fund. (Publication 3114.) Pp. 18. (Washington, D.C.: Smithsonian Institution.)

State of Connecticut. Public Document No. 24: Fifty-third Report of the Connecticut Agricultural Experiment Station, New Haven, for the Year 1929. Pp. xiii+926+lxi. (New Haven, Conn.)

Collection des travaux chimiques de Tchécoslovaquie. Rédigée et publiée par E. Votoček et J. Heyrovský. Année 3, No. 1-2: Janvier-février. Numéro commémoratif en l'honneur de Professeur František Wald. Pp. 134. (Prague: Regia Societas Scientiarum Bohemica.)

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 82. Cirripedia (*Balanus*) from the Miocene of New Jersey. By Henry A. Pilsbry. Pp. 429-433. (Philadelphia.)

United States Department of the Interior: Geological Survey. Water-Supply Paper 633: Surface Water Supply of the United States, 1926. Part 12: North Pacific Slope Drainage Basins. B: Snake River Basin. Pp. vi+263. (Washington, D.C.: Government Printing Office.) 40 cents.

U.S. Department of Commerce: Bureau of Standards. Circular of the Bureau of Standards, No. 389: The Making of Mirrors by the Deposition of Metal on Glass. Pp. 17. (Washington, D.C.: Government Printing Office.) 5 cents.

CATALOGUE.

Catalogue of Scientific Books and Publications of Learned Societies. (No. 364.) Pp. 74. (Cambridge: W. Heffer and Sons, Ltd.)

Diary of Societies.

MONDAY, APRIL 6.

INSTITUTE OF CHEMISTRY (Leeds Area Section) (jointly with Society of Chemical Industry—Yorkshire Section) (at Leeds).—Dr. H. J. Channon: Modern Aspects of Nutrition.

TUESDAY, APRIL 7.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Western Centre) (Annual General Meeting) (at Engineers' Club, Manchester), at 7.—J. W. Rissik and H. Rissik: Heavy-Duty Rectifiers and their Application to Traction Substations.

WEDNESDAY, APRIL 8.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Tees-Side Branch) (Graduate Section) (at Cleveland Scientific and Technical Institution, Middlesbrough), at 7.—Mr. Groves: Engineering and Metallurgy.

INSTITUTION OF ELECTRICAL ENGINEERS (Hampshire Sub-Centre) (at University College, Southampton), at 7.30.—L. C. Grant: The Breaking Performance of High-Power Switchgear and of a New Form of Quenched-Arc Switch.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY (Chemistry Section) (at Museum, Leicester), at 8.—Annual General Meeting.

TELEVISION SOCIETY (at University College).

THURSDAY, APRIL 9.

INSTITUTE OF MARINE ENGINEERS (Junior Section), at 7.—E. R. Chamberlain: Developments in Powdered Fuel Burning.

INSTITUTE OF METALS (London Section) (Annual General Meeting) (at 83 Pall Mall), at 7.30.—Discussion on The Effects of Re-melting and the Use of Scrap.

OIL AND COLOUR CHEMISTS' ASSOCIATION (at 30 Russell Square, W.C.1), at 7.30.—W. N. Bowran: Bitumens and their Use in Paints.

FRIDAY, APRIL 10.

ROYAL ASTRONOMICAL SOCIETY, at 5.—L. H. Thomas: A Criticism of Current Theories of Stellar Structure, and a Suggestion.—H. Roth: The Density Distribution in Capella.—Dr. H. Jeffreys: On the Cause of Oscillatory Movement in Seismograms.—S. F. Grace: Tidal Oscillations in Rotating Rectangular Basins of Uniform Depth.—G. Shajn: On the Behaviour of Certain Simple Multiplets in Stellar Spectra.

MALACOLOGICAL SOCIETY OF LONDON (at Linnean Society), at 6.

SOCIETY OF CHEMICAL INDUSTRY (Manchester Section) (Annual General Meeting) (at Engineers' Club, Manchester), at 7.—Dr. A. E. Dunstan: The Present Position of the Thermal Decomposition of the Lower Hydrocarbons.

OIL AND COLOUR CHEMISTS' ASSOCIATION (Manchester Section) (at Milton Hall, Manchester), at 7.—Annual Meeting.

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (at Technical College, Cardiff), at 7.15.—Annual General Meeting.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—F. Russell: Difficulties in Power Transmission by Belt and how to overcome them.

SATURDAY, APRIL 11.

GILBERT WHITE FELLOWSHIP (Annual General Meeting) (at 6 Queen Square, W.C.1), at 2.30.—Sir Richard Gregory, Bart.: Comets and Shooting Stars (Lecture).

PUBLIC LECTURES.

WEDNESDAY, APRIL 8.

ROYAL HORTICULTURAL SOCIETY (at Greycoat Street, S.W.1), at 3.30.—Prof. E. Baur: New Scopes and New Methods of Plant Breeding (Masters' Memorial Lecture).

THURSDAY, APRIL 9.

ROYAL HORTICULTURAL SOCIETY (at Greycoat Street, S.W.1), at 3.30.—Prof. E. Baur: The Problem of Evolution (Masters' Memorial Lecture).