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Empire Co-operation in Agricultural Research

THE term 'scientific' applied without qualification to the British Commonwealth Scientific Conference held on September 21–October 8 is scarcely accurate. Only a part of the machinery of science was under consideration: that part, especially of the sciences relating to agriculture, which is organized on a co-operative basis between the Governments of the British Commonwealth. The delegates to the Conference were mostly those concerned with the administration of Government scientific departments or of national research organizations; few were persons actively engaged in scientific work themselves.

Even within these limits, the field covered was a large and interesting one. Scientific co-operation of the kind that the Conference reviewed began in London, with a group of African Colonies that had a common interest in the development of knowledge of insect-borne diseases. The Entomological Research Committee set up by the Colonial Office in 1909 became a few years later the Imperial Bureau of Entomology, established on a wide basis of Empire co-operation and charged with the documentation of entomological knowledge and the identification of insects injurious to man and to his crops and stock. This was followed in 1920 by the formation of a similar, jointly maintained, central organization to deal with the fungi and bacteria that injure crops or are otherwise of economic importance—the Imperial Bureau of Mycology. As a result of the Imperial Agricultural Conference of 1927, eight new Imperial Agricultural Bureaux were established to cover the subjects of soil science, animal health, animal nutrition, animal genetics, plant genetics (other than herbage), plant genetics (herbage), fruit production and agricultural parasitology. At the same time the two older Bureaux became Institutes, as they had functions considerably wider than those assigned to the eight new Bureaux, which confine themselves to the collection and dissemination of information. The new Bureaux are attached to research institutes in their subjects at Rothamsted, Weybridge, Aberdeen, Edinburgh, Cambridge, Aberystwyth, East Malling and St. Albans, while the two older bodies are in close contact with the Natural History Museum, South Kensington, and the Royal Botanic Gardens, Kew, there being no research institutes specially devoted to entomology and mycology in Great Britain.

The activities of these ten organizations, a survey of which formed a major part of the work of the Conference, has recently been described in considerable detail in the seventh Annual Report of the Executive Council of Imperial Agricultural Bureaux*. The Council comprises representatives of the United Kingdom, of each of the five Dominions, of India, Southern Rhodesia, and the Colonial Empire. It administers a service of common Empire interest maintained from a fund jointly subscribed by all the members of the British Commonwealth. The acceptance by Governments of the scheme proposed by the 1927 Conference and extended by the Skelton Committee on Economic Consultation and Co-operation which followed the Ottawa Conference a few years later,

* Imperial Agricultural Bureaux, Seventh Annual Report of the Executive Council, 1935–1936. Pp. 102. (London: H.M. Stationery Office, 1936.) 5s. net.

brought into being a new type of Imperial organization. A glance at the Council's recent report, which indeed will well repay careful reading, indicates how rapidly the service thus set up has expanded and how clearly it seems in most cases to have met a need.

The primary function is information. The world literature on the subject with which each Bureau or Institute deals is surveyed and in the main abstracted. The aim in most cases is to miss nothing, no matter where or in what language it sees the light. The *Veterinary Bulletin*, published by the Imperial Bureau of Animal Health at Weybridge, noticed some 3,000 papers in its last annual volume. Early notice and sufficient detail to be of value to the worker who may be unable to secure or read the original paper are the keynotes of the service, the machinery for which has now been brought in most cases to a high level of efficiency. Special reports, in which the whole of the available literature on some particular subject is digested, are a feature of several of the Bureaux ; technical communications and bibliographies of others. Translations or long abstracts are provided by some, while several maintain lending libraries available throughout the Empire, and all are prepared to answer inquiries to the best of their ability. The two older Institutes are characterized, in addition, by a considerable organization for the identification of insects and fungi.

Visiting parties from the Conference spent much time in examining the work of these ten Bureaux and Institutes, and also in considering the possibilities of extending the organization to cover other fields, especially those of dairy science and forestry. What conclusions have emerged from the subsequent discussions in plenary session will, no doubt, become known in due course. At least one may hope that the report to Governments will recognize how much easier has been made the path of the research worker in many branches of agricultural science in knowing what has been and is being done in his chosen field, and thus set off, against the danger of superficialism to which such 'crammed' knowledge might lead, the increased efficiency that must come from the early and wide dissemination of the results obtained by other workers. It is a fair claim that in this kind of organization the British Commonwealth at present leads the world.

In its touring programme the Conference did not confine itself to these joint enterprises. Several of the agricultural, veterinary and dairying research institutes were visited and also some of those under the Department of Scientific and Industrial Research, and the Imperial Forestry Institute at Oxford. In all cases the inter-Imperial aspects of the work came under notice, but evidently more as a guide to the development of research in the various countries of the Commonwealth, than with a view to the extension of jointly financed research projects. Co-operation in Empire research, as distinct from the documentation of research, is tending more in the direction of interchange of programmes and personnel and the holding of conferences than in centralization of staffs and joint finance. It cannot be doubted that this is a healthy sign of the vigour of scientific development overseas, but it is equally clear that important research work is waiting on facilities that no single part of the Empire has as yet felt impelled to provide. Exceptionally there has been financial co-operation in research schemes on subjects such as the transport and storage of foodstuffs and locust investigations, centred at institutions in England, and proposals were before the Conference for a joint investigation into the control of termites. Usually, however, the investigational work done at a central station in the special interests of an overseas Government is paid for by an *ad hoc* grant from that Government, and such work is necessarily limited to problems on which some institute in the country is already engaged.

Considerable as is the field covered by the inter-Imperial organizations now in being, these limitations in their scope are leaving untouched many fundamental investigations that may not be urgent in any single member of the Commonwealth but are of great importance to the whole.

Another aspect of the Conference that should be mentioned was the emphasis laid on the value of the contacts established through the holding of periodical meetings not only of those charged with the direction of research but also of the actual workers in the different fields of applied science. Imperial Conferences are already held in a few subjects at intervals of five years or so, and an extension of this principle seemed to be indicated. Perhaps the greatest value of the Conference just concluded has been the opportunity it gave to members of getting to know the personalities and interests of their 'opposite numbers' in other parts of the Commonwealth and thus to secure a spirit of co-operation that is beyond the reach of official agencies.

A Social Analysis

The Anatomy of Frustration: a Modern Synthesis. By H. G. Wells. Pp. 274. (London: The Cresset Press, Ltd., 1936.) 7*s.* 6*d.* net.

TO the generation of readers immediately preceding the Great War, H. G. Wells (as a member of a deputation remonstrated with the Minister of Fine Arts, "On ne dit pas Monsieur Renoir, on dit Renoir") was the great illuminator, revealing the power of science to transform the material world, but on the men of science themselves his action has been different. He has awakened them to a consciousness of social disorder, disorder remediable by the application to mankind of the methods by which science is learning to control the other departments of Nature. In the laboratories either of the universities or the works, in the shops wherever the technicians congregate, the talk and thought are permeated by Wells, even though the participators have never read one of his books. Some of these men get labelled 'communists' because of their impatience with current government by slogans and the canons of good form; others incline to Fascism in the hope that a dictator would get things done. Even Wells has flirted with the Fascist idea of the need of a great man, though his leader would be the entrepreneur who had proved his quality in big business. Whatever the particular manifestation may be, the young workers in science to-day no longer regard 'politics' as unworthy of their interest; they are looking for social reconstruction directed by science, and consciously or not, Wells has been the catalyst that has initiated the reaction.

In this latest book "The Anatomy of Frustration" Wells adopts an odd technique. He puts his opinions into the mouth of Mr. Steele—inventor and business man, who after the War had retired to the south of France in order to sort out his ideas about life. This gives Wells the opportunity of a running commentary and of anticipating in advance the scepticism which is part of the outfit of the man of science. He explains his title; Burton's "Anatomy of Melancholy" was an analysis of the despair with which the thinking man of his epoch must regard the world—a universe wholly and irremediably mad. Steele embarks on his examination of frustration in the modern world with the firm determination that a remedy can be found by the methods he has found valid in that section of which he had experience. He starts with a brave assumption—that all men can and ultimately will think very much alike: "Men have no right to a thousand contrasted faiths and creeds and . . . the multitudinousness of people in these matters is merely due to bad education, mental and moral indolence, slovenliness of statement and the failure to clinch issues"; and so we pass on to a discussion of religion and immortality, and of morality that needs re-expression in terms of daily life.

"Motives are things of deeper origin than intellectual convictions and the real will of *Homo sapiens* is still largely unaffected by his conscious and formulated wishes. His intentions are one thing; his behaviour quite another. The world's expressed desire, its conscious desire, is such and such; the total complex of human impulses is quite another system, darker, deeper and profoundly more real. These desires for world unity and sane economics are conscious and intellectual desires, and they scarcely penetrate at all into the more primitive and substantial mental mass which is the true reservoir of motives and impulses."

But for all that, Steele is not prepared to yield to the sub-conscious—"The essential purpose of all law, all discipline, all training, is the enthronement of a clear general purpose above a subjugated and directed subconsciousness".

Steele would not be Wells if he did not knock a good many heads along his route; socialism is a case of "habitual piecemeal thinking"; "the Moscow frustration is a study in the deterioration of yet another blazing star of hope"; "the League of Nations recognises, intensifies, and does its utmost to preserve the conventions of nationalism and the emotions of patriotism"; schools and colleges are to this day "conducted to put back the new generation where its parents began". Steele has no use for all sorts of things—The People, Zionism and other separatist movements ("Why specialise in Erin and Mother India and Palestine, when the whole world is our common inheritance. *Come out* of Israel"), Liberalism ("The stupid can co-operate loyally upon immediate objectives; the intelligentzia, it seems, cannot co-operate at all"), and the artistic temperament ("Indulgence of appetites to the detriment of fitness and the distraction of energy").

Is there nothing constructive about Steele? He attaches extraordinary importance to the production of that 'World Encyclopædia' of his. It seems to him that it is "the most urgent need of

our time. The main intellectual task of education is to put before the expanding mind everything that is clearly known about the nature of the world in which it finds itself". Of such is to be the new education, and we may suppose that it was under the urge of Steele that Wells set about the "Outline of History", and the "Science of Life", as samples of that great and continuous synthesis the World Encyclopædia is to be. And so Wells ends as he has begun and continued—a solvent and a loosener of mental inhibitions, for until freedom is obtained no orderly co-operation of men with men can proceed. "Fine confused thinking" perhaps, but how stimulating; it is better to clear the mind than to trim it into a system.

A. D. HALL.

Wild Animals at Large

(1) Hunting Wild Life with Camera and Flashlight:
a Record of Sixty-five Years' Visits to the Woods and Waters of North America. By George Shiras, 3d. Vol. 1: Lake Superior Region. Pp. xxiv+450. Vol. 2: Wild Life of Coasts, Islands and Mountains. Pp. x+450. (Washington, D.C.: National Geographic Society, 1935.) 2 vols., 5 dollars.

(2) La vie des animaux sauvages de l'Afrique
Par Dr. Émile Gromier. (Bibliothèque géographique.) Pp. 343+36 plates. (Paris: Payot et Cie, 1936.) 40 francs.

(3) Parade of the Animal Kingdom
By Prof. Robert Hegner, assisted by Jane Z. Hegner. Pp. vii+675. (New York: The Macmillan Co., 1935.) 21*s.* net.

THE art of the camera seems almost wholly to have displaced that of the pen and pencil in the illustration of popular works on animals, and these three books, dealing with wild life in their own special ways, owe a large share of their attractiveness to the photographs which, apart from a couple of maps and a rough sketch, are their only pictures.

(1) The first is an outstanding work of its kind, and must be looked upon as a classic in the history of wild life photography. Its author, George Shiras, born in Pittsburg in 1859, is the pioneer of American Nature photographers. Laying aside the gun for the camera in 1889 he was, according to E. W. Nelson, former chief of the U.S. Biological Survey, the first to photograph animals from a hide in daytime, to make wild animals take their own photographs by operating the camera shutter during the day and with flashlight at night, to use two flashlights and two cameras so that the first caught the wild creature at rest and the second at the moment of its alarm, and the first to practise wing-shooting by means of a specially mounted camera which enabled him to photograph wild fowl flying at great speed. The cinematograph has displaced the camera for some of these purposes, but it has not done more beautiful work than some of the still pictures made by Shiras with his simpler apparatus.

In other ways the author has been a champion of wild life in the United States: his observations and his advocacy led the movement for the preservation of disappearing birds and beasts and for the establishment of national reserves, as they lay at the foundation of the Federal Migratory Bird Law and the Migratory Bird Treaty in which Great Britain co-operated. The articles which make up these two volumes have appeared from time to time in the *National Geographic Magazine*; here they are revised, with much new matter and previously unpublished photographs added. They are chatty, straightforward accounts of the author's long experience of wild life in various parts of North America, and discuss the habits of a great range of animals. The articles are illustrated by striking photographs, none of which could exceed in beauty the pictures of some of the fungi which accompany the article on "Camp Flowers in Northern Michigan".

(2) Dr. Gromier unites in himself two apparent incompatibles, the enthusiastic protector of wild life whose ardent desire is that the nations should unite to conserve the unique fauna of Africa, and the sportsman who on occasion bags the outstanding trophy when it presents itself. He offers advice to sportsmen on the preparation necessary for long journeys in wild country and on the choice of arms and ammunition, and follows his advice with hints upon the photography and filming of wild animals. Photography bulked largely in his own expeditions, and his photographs, although many show signs of amateurish retouching, add to the interest of the text, and indicate the author's intrepidity in the presence of the most dangerous of Africa's big game.

The author gives vivid accounts of journeys in pursuit of elephant, rhinoceros, hippopotamus,

lion, buffalo, eland, giraffe and gorillas. To each of these is given a chapter recounting such habits as came under observation, but the observations do not add much to the already fairly extensive knowledge of the fauna. The author had the good fortune to observe and photograph an albino elephant in Cameroon, and his encounter, twenty-five years ago, must be one of the first records of the nightly nests or platforms of branches built by the gorillas of Kivu, some solitary, some grouped, and some apparently built for two individuals, but all defiled by the excrement of their tenants. An interesting feature is the reproduction of forty-three illustrations showing the spoor of various creatures.

(3) Dr. Hegner's book is of a type different from the two preceding. It is not a work of personal experience, but an account, meant for the layman, of many characteristic representatives of the various groups of animals. The account is systematic in that it follows the recognized sequence from Protozoa to the higher monkeys, but its method is unconventional, and the simplicity and liveliness of its language, the beauty of its photographic illustrations by experts and specialists, and its avoidance of technical terms in description and even in naming (scientific nomenclature is omitted), will commend it to many who wish to obtain an accurate and wide but not technical knowledge of the animal kingdom. J. R.

World Weather

Manual of Meteorology

By Sir Napier Shaw, with the assistance of Elaine Austin. Vol. 2: Comparative Meteorology. Second edition. Pp. xlviii+472. (Cambridge: At the University Press, 1936.) 36*s*. net.

THE four volumes of Sir Napier Shaw's monumental "Manual of Meteorology" bear the titles: (1) "Meteorology in History"; (2) "Comparative Meteorology"; (3) "The Physical Processes of Weather"; (4) "Meteorological Calculus: Pressure and Wind". Vol. 2, which after eight years now appears in second edition, gives in a descriptive form our present-day knowledge of the weather all over the world. Sir Napier's comprehensive view of this subject has taken its most perspicuous form in a great number of charts dealing with the entire earth, in most cases given in polar projection for the northern and the southern hemisphere separately. These charts have since their appearance in 1928 exerted a great influence upon the views of meteorologists, and selected samples of them have been reproduced in more than one of the text-books published since that date.

Referring to the great amount of new observational data which has become available during the last eight years, Sir Napier says in his preface: "A complete revision of the representation of meteorological data from the point of view of 1935 instead of 1927 is not possible". As regards diagrams and charts he has, therefore, with good reason limited his efforts to correcting errors and omissions, and substituting a small number of new figures for old ones. The most important new features are discussed in a concluding chapter of "Notes and Supplementary Tables". Characteristic of Sir Napier's sense of humour, this exceedingly useful chapter is headed by the device: "The end must justify the means". These notes show as a matter of fact how Sir Napier still follows with the keenest interest the progress of his science in every detail.

After consideration in Chapter vii of changes in the general atmospheric circulation, Chapter viii and the subsequent chapters deal with the description of the transitory changes in weather conditions, including the description of cyclones and anticyclones. This is a field of rapid scientific progress, and here the greatest changes in the new edition are found. I believe that I can see one of the leading ideas of Shaw's own work reflected in his description of Sir Francis Galton's admirable contribution to the study of transitory changes. On p. 374 we read these characteristic lines, which appear for the first time in the new edition:

"The possibilities of these records have never been explored but their use still remains an obvious responsibility to British meteorologists. It is rather pathetic to remember that after reproducing actual curves for twelve years with all the machinery for continuing the practice the experts at the time preferred the tabulation of five-day means of hourly values and the passing of the original curves through a mechanical harmonic analyser. Every page is suggestive to those who have opportunity of studying it."

I would give these words my full approbation. Sir Francis Galton's records (*Quarterly Weather Report* for the years 1869–80) are a gold-mine which has remained almost unexploited. As an example how they may inspire useful work even to-day, I may refer to a note just recently

published by Dr. T. Bergeron, "L'Utilisation des 'Météorogrammes' pour les recherches synoptiques" (*Assoc. Meteor. l'U.G.C.I.*). Speaking of the Galton records he says: "Voila la plus admirable publication de données météorologiques existante!"; and he justifies these words by giving some examples of how the results found in recent years by the highly developed modern weather-chart analysis might have been found with greater ease sixty years ago by the Galton records combined with the weather charts of those days.

But meteorologists did not find this most direct way. The method of averaging directed attention away from the minute examination of individual cases. It is a great merit of Sir Napier that, in spite of all, he never lost his interest for the individual case. He succeeded in understanding the records more fully than his predecessors. A typical protest from his side against the tendency of making all characteristic features disappear by the formation of averages is represented by Fig. 218 (Fig. 211 of the first edition), showing his view of the structure of a cyclone. I have always admired this figure, which appeared almost as a joke, and which ultimately has showed itself to contain so much of concealed truth.

Readers of Sir Napier Shaw's "Manual" will find a special charm in the bold but striking statements so frequently met with in all his writings. The reading of the more than 1,500 pages of his great work, therefore, never becomes dull. This is certainly one of the reasons why the second edition comes so soon after the first one. Sir Napier Shaw is to be most heartily congratulated on the well-deserved success of his great work.

V. BJERKNES.

Geography and Distribution

Plant and Animal Geography

By Dr. Marion I. Newbigin. Pp. xv+298. (London: Methuen and Co., Ltd., 1936.) 12*s*. 6*d*. net.

BY the death of Dr. Marion Newbigin in 1934, geographical science suffered a serious loss. Fortunately her book on biogeography was being prepared for the press, and with the co-operation of Miss Florence Newbigin and Prof. H. J. Fleure, who revised the work, it has now been published.

On such complex problems as the distribution of animals and plants, and the means by which it was brought about, Dr. Newbigin was able to take a broad outlook. Her view was almost detached. She possessed a certain clarity of mind, which enabled her to distinguish between general principles and details; and a power of lucid expression rare among scientific writers. The result is this clear and readable book.

To the student of distribution, one of the main difficulties to a clear understanding of the problem is the fact that, while the geographical causes (in the strict sense) remain constant, the results are very different, mainly owing to the different means available for dispersal. That is to say, the same barriers, ocean, desert, mountain range, and the same land bridges, exist for animals as for plants; yet they operate in very different degrees. Nevertheless, we should expect to find some correspondence at least between the distribution of animals and plants; and it is this which Dr. Newbigin brings out clearly.

Beginning with a general description of the higher forms of life in relation to environment, the author passes on to an outline of taxonomy—not in itself a concern of the geographer—and thence to a description of the principal plant communities with their animal complements. These studies prepare the student for the most important chapters in the book, those dealing with the major faunal and floral regions of the world. Here Dr. Newbigin is at her best. She tries, with considerable success, to reconcile the divergent views of botanists and zoologists as to the main biogeographical regions, while recognizing that complete reconciliation is not possible. As she points out, there is not the same unanimity among botanists that there is among zoologists as to how the earth should be divided. Even if the former confines himself to the flowering plants, his present material is enormous, and the geological record less perfect than it is for mammalian remains. With regard to this last, however, the author is perhaps unduly pessimistic. The fact that there are vastly more flowering plants than there are mammals, while making the problem more difficult, increases the chance of fossil remains being found; and it would indeed be strange if plants—even herbaceous ones—had failed to leave clues which the ingenuity of scientific investigators could follow up. One key to the identification of recent floras has been found in their seeds; and the work of Mrs. E. M. Reid on Pliocene floras in western Europe confirms that of other palæobotanists that, since Tertiary times,

plants, like animals, have followed a general southerly direction. It is possible that we know almost as much about Pleistocene floras in Europe as we do of Pleistocene mammals.

In stressing the importance of mountain barriers, such as the Himalaya, to animal and plant migration, the author is apt to overlook the fact that, so far as plants are concerned, they act as carriers as well as barriers. The east to west distribution of alpine plants is to be ascribed to the great Tertiary uplifts of Eurasia; and this movement has to some extent masked the north to south movement, further complicating the problem for the botanist. But the Himalaya was certainly most effective as a barrier just at the most critical time, namely, during the glacial epoch, when great numbers of species which might otherwise have made good their escape southwards, found their way barred, and perished. Almost unconsciously, as it appears, Dr. Newbigin pays tribute to the general truth of Willis's 'Age and Area' hypothesis; for on p. 216 we read: "Thus the problem of distribution for any type seems to resolve itself into the time factor, the length of time which has elapsed since its origin, and the checking factor . . ."

In the opinion of the reviewer, this is the best general account which has appeared for some years of plant and animal distribution, its causes and consequences. The book is well printed and adequately illustrated; although it might be as well to add a map in any future edition showing at least the fourteen botanical regions commonly accepted by geographical botanists. Only the expert can correlate these for himself with the zoological map facing p. 244.

Mélanges Pelseneer

Mélanges Paul Pelseneer
(Mémoires du Musée Royal d'Histoire Naturelle de Belgique, Deuxième Série, Fasc. 3). Pp. ii+1206. (Bruxelles: Musée Royal d'Histoire Naturelle de Belgique, 1936.) n.p.

THIS handsome volume, containing contributions from among the most distinguished of his fellow workers in eleven countries, is dedicated to the eminent zoologist Paul Pelseneer "en témoinage de profonde reconnaissance et de respectueux admiration". Although he is pre-eminently a malacologist, his interest in all aspects of zoology is well known, and there are few groups in which he has not worked. A knowledge of this interest is manifest in the wide range of subjects chosen by the sixty-six authors represented, for nearly every animal group is included, from Protozoa to man, and each contributor choosing the subject specially his own in many cases has chosen one already in some measure touched upon by his illustrious colleague.

Not only in malacology but in the general papers also this interest is felt. Strohl's work on bipolarity is a case in point, and the paper by Pérez dealing with the influence of trematode sporocysts on the genital glands of *Turritella* recalls to us the fact that Pelseneer has himself investigated the larval trematodes parasitizing various molluscs, and has recorded several new species. In this connexion also comes Van den Berghe's ecological account of Congo molluscs as hosts for trematode cercariæ. It is the same with the Crustacea. Among the four papers dealing with this group, Redeke, in his research on *Atyaephyra desmaresti*, follows in the footsteps of Pelseneer, who was the first naturalist to record this species from Belgium.

Naturally the molluscs predominate, twenty-four of the contributions being devoted to them. To select two bearing specially on Pelseneer's own work we may mention Odhner's extensive paper on the Nudibranchia Dendronotacea, emphasizing our indebtedness to that author's exact investigations which afford such a solid basis for a modern natural classification, and Orton's observations and experiments on sex-change in the European oyster *Ostrea edulis*, in which he acknowledges "inspiration and advantage from this distinguished and honoured colleague". Yonge, on the evolution of the swimming habit in the Lamellibranchia, has chosen a subject peculiarly his own; and Navez, in his observations on the cardiac rhythm of *Anomia simplex*, offers a very interesting subject in a totally different field.

Four papers deal with echinoderms. Here Hörstadius's "über Heterosperma Seeigelmerogone" stands out. His beautiful and exact work, entailing the finest microtechnique, is well known, and needs no introduction here.

Physiology, embryology, ecology, morphology and systematics all have their share of attention, both in the mollusca and elsewhere. It is, however, impossible to mention them all in so short a space. All are valuable and interesting, and the whole volume is well got up and well illustrated.

(1) Botany for Children
By Lady Elphinstone. Pp. iv+160+12 plates. (London: Burns, Oates and Washbourne, Ltd., 1936.) 3*s*. 6*d*.

(2) The Junior Gardener
By Harriet Price. Edited by Walter P. Wright. Pp. xii+134+4 plates. (London: J. M. Dent and Sons, Ltd., 1936.) 5*s*. net.

THAT the child is indeed father of the man is being made increasingly obvious by the findings of modern psychological research. Any books, therefore, that aim at awakening in the developing child a sincere interest in a human activity so worth-while as the study and cultivation of plants are to be welcomed.

(1) In "Botany for Children" Lady Elphinstone revives a method of exposition very popular in the early part of last century. Jean, Mary and John, three inquiring children, learn about the characters of British plants from the lips of Dame Nature. The idea is, on the whole, well carried out; but the terms order, family, genus and species are used exceedingly loosely throughout the book. There are line block and coloured illustrations, the latter being arranged on a novel plan. The whole plant (including root) is shown against a background of its usual habitat, with a single fruit inset in one corner. On the whole, the paintings are accurate and give a fairly good impression of the plant.

(2) "The Junior Gardener" is written to help boys and girls who are taking up practical gardening for the first time, whether at home or at school. It tells in simple language how to carry out the various basic operations of gardening, and is fully illustrated with diagrams, drawings and coloured plates. The author has had personal experience of the problems of school gardening, and the chapter devoted to that subject should prove one of the most valuable in this well-planned and well-written book. J. S. L. G.

Mercury Arc Rectifier Practice
By F. C. Orchard. Pp. xi+224+23 plates. (London: Chapman and Hall, Ltd., 1935.) 15*s*. net.

DURING recent years there has been an increasing demand for machines and devices which will convert alternating currents into direct currents. Bulk supplies are usually given by alternating currents, but for some supply networks and for traction, direct currents are required. In these circumstances, devices such as machines called rotary converters, or stationary apparatus utilizing a physical property of electrolytes—electric arcs, gas discharge tubes, etc.—are employed. The latter kinds of apparatus are called rectifiers and are of many types utilizing very different physical phenomena.

Most books on rectifiers devote much time to explaining the mathematical and physical theories on which the working of the various kinds of rectifiers is based. To the men who have to instal and operate the glass bulb and steel tank types of mercury arc rectifiers used commercially for service on public supply systems, on railways and for industrial purposes generally, a book that will assist them in their daily work is required, and we think that they will find the book under notice a real help.

Handbuch der Geophysik
Herausgegeben von Prof. Dr. B. Gutenberg. Band 1, Lief. 3: Breitenschwankungen, von Prof. Walter D. Lambert; Theorie des irdischen Schwerefeldes, von Prof. E. A. Ansel. Pp. iv+501–730. Lief. 4 (Schluss des Bandes): Beobachtung der Schwerkraft; Die Lotabweichungen; Das Problem der Isostasie. Von Prof. Dr. W. Heiskanen. Pp. 731–970+xv. (Berlin: Gebrüder Borntraeger, 1934, 1936.) 31 gold marks each part.

DR. LAMBERT'S account of the variation of latitude is good, but a little too brief. Ansel on the theory of the gravitational field is mostly excellent, and so is Heiskanen on observations of gravity, pendulum deflections, and isostasy. Ansel claims to have detected an algebraical error in Darwin's theory of the figure of the earth, which affects the sign of the term in $\sin^2 2\varphi$, and he is apparently supported by Heiskanen. Here I think Darwin is right. One misses an account of the important work of de Sitter and his colleagues. Such omissions, however, are very few. These parts complete vol. 1 of the "Handbuch"; vols. 2 and 4 are already complete. H. J.

Lessons in Elementary Analysis
By Dr. G. S. Mahajani. Second edition. Pp. xii+264. (Poona: Aryabhushan Press, 1934.) n.p.

THIS book, first published in 1929, is designed to cover the analysis required for the bachelor's degree in most of the Indian universities. It deals mainly with the theory of number, in which there is an interesting examination of Dedekind's method; the theory of limits; infinitesimals and continuity; the mean value, Maclaurin's and Taylor's theorems; Riemann integration; infinite integrals, uniform convergence and Fourier series. There is also a useful addendum on beta and gamma functions, power series, the application of Taylor's theorem to functions of several variables, Euler's theorems on homogeneous functions and Young's theorem on implicit functions.

Each chapter contains a set of exercises for the student, and the text is thoroughly well written, the exposition of difficult points being exceptionally clear. The book should serve admirably the purpose for which it was written.

Praktische Übungen zur Vererbungslehre:
für Studierende, Ärzte und Lehrer. Von Prof. Dr. Günther Just. Zweite vermehrte und verbesserte Auflage. Teil 1: Allgemeine Vererbungslehre. Pp. vi+137. (Berlin: Julius Springer, 1935.) 6.90 gold marks.

ALTHOUGH small, this compactly produced book contains a well-arranged exposition of methods in genetics. While mainly devoted to statistical methods, it includes measuring instruments, the technique of breeding *Drosophila*, and different types of mouse cages. The statistics deal with continuous and discontinuous variation, the binomial curve, correlation tables, back-crossing, sex-linked characters, the testing of Mendelian ratios, the χ^2 test and other methods commonly used by geneticists.

Trends in Modern Physics*

By Prof. Allan Ferguson

THE world-picture of the older generation was, as we look back on it to-day, extraordinarily simple. It is, or has been, the fashion to describe nineteenth-century science as materialistic. There certainly was Buchner, and there was Tyndall's Belfast address. But *Dr. Stoffkraft* had neither a long reign nor an influential following, and we shall be nearer to the truth if we look upon Victorian science as showing a simple realism—the realism of the man in the street—not wholly unrelated to that simple realism of to-day which sees in an alpha-ray track evidence for the existence of an atom, of the same order as that furnished by a diffraction photograph (or, for that matter, by our own eyes) for the existence of a star.

What we have learned to call the classic outlook was based on those notions of velocity, acceleration, momentum and force which were first formed into an ordered scheme by the genius of Newton—a scheme which sufficed to describe, succinctly and clearly, the series of perceptions involved in such phenomena as the motion of a pendulum, a billiard ball, a railway carriage, and (with certain reservations concerning fine points) the complex motions of the bodies of the solar system. The physical science of the eighteenth and nineteenth centuries was occupied in extending and clarifying these concepts, although eighteenth-century science in England was hampered by an excessive devotion to the memory of Newton, which committed the English mathematicians to the fluxional notation. It required the formation of a society at Cambridge "to inculcate the principles of pure *d*-ism, and to rescue the University from its *dot*-age", before the British physical school could rival the advances of their Continental brethren.

As we have said, the attitude of the physicist to the fundamentals of his science was, in general, naïvely realistic. Mass was quantity of matter, and matter itself was defined as "that which can be acted upon by, or can exert force", or alternatively "that which may have energy communicated to it from other matter". *Obscurum per obscurius*, with a vengeance!

Quantitatively, mass was defined, following Newton, as the product of volume and density; and even Thomson and Tait are roused to a hint (without attempting to resolve the difficulty) that such a process results in a circular argument, inasmuch as we have no other way of defining density than as the ratio of mass to volume.

Early in the nineteenth century, discoveries, mainly in the realm of chemistry, gave fresh interest to atomic doctrines, and the simple concept of the billiard-ball atom proved to be brilliantly successful in explaining old happenings and in predicting new ones. It is not immediately obvious that an extrapolation of those laws which describe the motions of bodies of the dimensions of a locomotive or a planet down to bodies of the indescribably minute dimensions given to an atom or molecule is likely to be successful in subsuming certain perceptual events; the extraordinary thing is, not that such an extrapolation should break down somewhere, but that it should have any validity at all; and the triumphs to be put to the credit of the hypothesis are sufficiently remarkable, as any treatise on the kinetic theory of gases will testify.

No survey of the physical science of the last generation would be complete did it contain no reference to radiation and to the nineteenth-century concept of the mechanism by which radiation is conveyed. Despite the difficulty of framing a theory of the ether which should satisfy dynamical laws—"Why should it?" we might remark incidentally to-day—the concept of an ether of space was so brilliantly successful in correlating and predicting so many and so diverse phenomena—we need but instance that bending of light round corners which we call diffraction, that alternate heaping up and destruction of light which we term interference, and that remarkable refraction of a ray of light by certain crystals as a cone of rays—as to draw from Lord Kelvin the downright statement, "This thing we call the luminiferous ether . . . is the only substance we are confident of in dynamics. One thing we are sure of, and that is the reality and substantiality of the luminiferous ether". Strange reading, to-day; and reading which might well introduce a note of hesitation into some of the confident declarations of present-day realities.

Molar mechanics, the billiard-ball atom, the ether: the nineteenth century had built on these apparently stable foundations an immense structure of ordered knowledge. The closing years of the century were fated to show cracks in the superstructure and weaknesses in the foundations.

* From the presidential address to Section A (Mathematical and Physical Sciences) of the British Association, delivered at Blackpool on September 11.

The facts of radioactivity and the discovery of the electron showed that the concept of the atom must increase in complexity were it to remain competent to subsume the additional perceptual facts ; and the experimental study of the radiation from a hot body revealed a state of affairs inexplicable on the lines of classical theory, as did the investigation of the phenomenon known as the photo-electric effect.

It is unnecessary to tell in detail the story of the introduction into physical science of the revolutionary notion of quantization ; of the concept of the nuclear atom ; of the rationalization of the facts of spectroscopy by the application of quantum ideas to the nuclear atom ; of the breakdown of this latter concept when applied to atoms more complex than a single electron system ; of the building up on quasi-empirical lines of a vector model of the atom which should be capable of providing an explanation for the complex facts of spectroscopy ; of the further emphasis placed on that dualism of outlook which appeared so early in twentieth-century physics by the discovery of the Compton effect and by the investigation of electron-diffraction and of molecular-ray diffraction ; and of the impending disappearance of that dualism under the impact of the analysis of the last decade.

Atomum expellas furca—and there is something appropriate in giving such a designation to a Ψ-function—*tamen usque recurret*. If two of the high lights of twentieth-century physics are provided by the introduction of quantum ideas and by the identification of mass and energy, a third is provided by that remarkable rain of sub-atomic particles which has increased incredibly in intensity since the discovery of the electron more than a generation ago, and has provided opportunities for nucleus-building of which theorists have not been slow to make use.

By nothing has the world-picture of to-day been so transformed from that of a generation—nay of a decade—ago than by the introduction of the uncertainty principle and by its effect on our notions of causality.

It can be shown that of two conjugate quantities —time and energy, or position (x) and momentum (p)—the product of their uncertainties of determination can never be less than the quantum h. Thus an increase in the accuracy of the determination of one quantity necessitates a corresponding decrease in the accuracy of the conjugate quantity, and in particular the exact determination of one quantity leaves the other completely undetermined. An attempt to determine the position of a particle involves its illumination by light of suitable wave-length, and decrease of the wave-length in order to improve the definition of its position involves an increase in the magnitude of the recoil due to the Compton scattering process.

Following a suggestion of Dr. H. T. Flint, let us fix our attention on the quantities position and momentum, and consider a co-ordinate system in which momentum (p) is plotted along one axis and position (x) along the other. The co-ordinate space gives us the possible simultaneous values of x and p. Suppose this space divided into rectangles each of area h. Then the uncertainty principle, which asserts that the product ($\delta x \delta p$) of the uncertainties of the determination of position and momentum can never be less than h, may be illustrated by resuscitating Maxwell's demon and permitting him to push a point about at will within any one of the rectangles. The movement of the point, that is, the corresponding changes of position and momentum, will not be detected, for they do not correspond to any detectable change in the world of sense.

Unfortunately the word 'indeterminism', which has other connotations, has become associated with the statement of the principle. Many will recollect Clerk Maxwell's immortal account of the proceedings of Section A at the Belfast meeting of the British Association sixty-two years ago, when Mr. Herbert Spencer regretted "that so many members of the Section were in the habit of employing the word Force in a sense too limited and definite to be of any use in a complete theory of evolution. He had himself always been careful to preserve that largeness of meaning which was too often lost sight of in elementary works. This was best done by using the word sometimes in one sense and sometimes in another, and in this way he trusted he had made the word occupy a sufficiently large field of thought".

Is it heresy to suggest that some of us who have sung canticles in praise of indeterminism and the disappearance of causality have given a similar generousness of meaning to these words ?

Similar considerations apply to the term *observable*, which has suffered a sea-change in transference from its ordinary usage in the realms of perception. There is quite as much complicated physical theory lying between the perceptually observable marks on a photographic plate and the inferred frequencies, as there is between similar perceptual observables and the non-observable electron orbit or state which was inferred in order to subsume the perceptual facts. A similar generosity of treatment is accorded to the term *observe* when it is applied to the conceptual experiment for the determination of the position of a particle such as an electron.

Which brings us round to the starting-point of this discourse. Many of us who desire to proceed

with our measurements untrammelled by these philosophic doubts have asked if there is not some canon by which the plain man could test his every-day beliefs. I suggest that a starting-point at least to this end is provided by a study of Karl Pearson's work, and that, with certain reservations and additions to the method discussed in the "Grammar of Science", we may develop a canon which will serve as a guide through the jungle of additional perceptual facts which the physical science of the twentieth century has added to that of its predecessors.

Those who discuss the doctrine of causality do so with little reference to the attitude taken by the philosophers, and it may not be without interest—it certainly has some bearing on present-day thought—to consider the development of the notion of cause since the time of Newton. The views of Locke, Newton's elder contemporary, are clear and simple. He remarks: "Thus, finding that in that substance which we call *wax*, fluidity, which is a simple idea that was not in it before, is constantly produced by the application of a certain degree of heat, we call the simple idea of heat in relation to fluidity in wax the *cause* of it, and *fluidity* the effect. . . . So that whatever is considered by us to conduce or operate to the producing any particular simple idea, whether substance or mode, which did not before exist, hath thereby in our minds the relation of a cause and so is denominated by us".

Newton, dominated as he was by the principle of causality and ever searching for a clear physical picture of the results of his investigations, was capable of a philosophic breadth of view which needs surprisingly little modification to-day. He makes, for example, a physical picture of matter as formed in "solid, massy, hard, impenetrable, moveable particles", and assumes that they have not only a *Vis Inertiæ*, but are moved by certain active principles, such as gravity. These principles are to be considered "not as occult qualities . . . but as general Laws of Nature . . . their Truth appearing to us by Phænomena. . . . To tell us that every Species of Things is endowed with an occult specifick Quality by which it acts and produces manifest effects, is to tell us nothing; but to derive two or three Principles of Motion from Phænomena and afterwards to tell us how the Properties and Actions of all corporeal Things follow from these manifest Principles would be a very great step in Philosophy, though the Causes of those Principles were not yet discovered; and therefore I scruple not to propose the Principles of Motion above mentioned, they being of very general extent, and leave their Causes to be found out". Evidently Newton takes the view that we have made an important step forward when we have subsumed a number of perceptual facts under a general formula.

It is to Hume, though he may owe something to Glanvil and other predecessors, that we are indebted for a clearly ordered statement of the experientialist doctrine of causation. The generalization, for example, that the earth attracts a stone is explained as a generalization from thousands of observations. "Adam . . . could not have inferred from the fluidity and transparency of water that it would suffocate him, or from the light and warmth of fire that it would consume him. No object ever discovers by the qualities which appear to the senses, either the causes which produced it or the effects which will arise from it; nor can our reason, unassisted by experience, ever draw any inference concerning real existence and matter of fact".

Mill further developed the experientialist doctrine in the statement that the law of causation "is but the familiar truth that invariability of succession is found by observation to obtain between every fact in nature and some other fact which has preceded it, independently of all considerations respecting the ultimate mode of production of phenomena, and of every other question regarding the nature of things in themselves". To the doctrine of succession in this simple form the objection has been urged that day may be regarded as the cause of night and conversely. Mill meets this objection by pointing out that invariable sequence does not necessarily involve causation. To involve causation the sequence must not only be invariable but also *unconditional*. The day-night sequence is conditioned by the sun and so does not conform to this test. "We may define, therefore, the cause of a phenomenon to be the antecedent, or the concurrence of antecedents, on which it is invariably and unconditionally consequent".

It is difficult to sum up Pearson's attitude to the problem of causality and to the general problem in a few sentences. Perhaps Kirchhoff's dictum concerning mechanics: "Die Mechanik ist die Wissenschaft von der Bewegung; als ihre Aufgabe bezeichnen wir: die in der Natur vor sich gehenden Bewegung *vollständig* und *auf die einfachste Weise* zu beschrieben", touches very nearly the root of the matter.

We live, in fact, amid a mass of perceptions; and it is the business of physical science to correlate, in as simple a fashion as may be, a certain section of these facts. To this end the physicist devises a *conceptual* world of atoms and molecules, from which he builds up a system—a world-picture—of molar masses whose motions correspond to the routine of our sense impressions. Given a frame of reference, we can formulate laws of

motion for two isolated particles in a conceptual world which may be summed up in the statement that whatever be the positions and velocities of the particles the ratio of their accelerations is always constant; this ratio is defined as the inverse mass-ratio of the particles; and in virtue of this we have the relation that—

Mass of A × acceleration of A =
mass of B × acceleration of B.

We give the name *force* to this product, and hence obtain the law that action and reaction are equal and opposite. On the basis of such definitions we can build up a structure of bodies in the conceptual world the motions of which, predictable under the descriptive laws formulated, will agree with the routine of our world of sense perceptions. We have, in fact, *explained* certain phenomena.

There is, of course, no logical reason why, in this description, we should stop short at the second derivative—acceleration—or go forward to it for that matter. We are concerned to find the simplest and most consistent explanation, and this procedure provides it. Indeed something of æsthetics may also influence our choice.

The atom, whatever its complexity, whether the concept remains sharp as that of a billiard ball or a miniature solar system, or whether its outlines disappear in a probability-smear, remains a *concept* outside the realm of perceptual happenings which it is the business of the concept to correlate. It may or may not emerge into the perceptual world; unless and until it does, discussion of its reality is beside the mark.

Planck, defining the causal condition in the statement that an event is causally conditioned if it can be predicted with certainty, goes on to remark that the possibility of making a correct prediction has not to be interpreted as anything more than a criterion for a causal connexion, but that the two do not mean one and the same thing. Day is not the cause of night, although we may be able to predict the advent of night in the daytime. Day is, therefore, a causally conditioned event.

Taking the definition as it stands, we find that in the realm of quantitative physical events we cannot, purely as a matter of measurement, predict *accurately* in advance any one physical event—this, without introducing quantum considerations. Prof. Planck escapes from the indeterminist position by transferring the definition to a conceptual world in which exact measurements may be made and events correctly predicted. He assumes, in fact, in its broad outlines, the thesis of the "Grammar of Science". He thus retains the principle of causality, as defined above, in the happenings of the conceptual world, remarking that the relation between events in the perceptual and conceptual worlds is subject to a slight inaccuracy.

The introduction of Heisenberg's uncertainty principle necessitates a corresponding process in dealing with perceptual problems from the point of view of quantum physics. A conceptual world of quantum physics is framed in which a strict determinism reigns. True, the world has not so many points of resemblance to the perceptual world as had the older schemes—billiard-ball and solar-system atoms have disappeared, and the wave-function, which does not refer to ordinary space, is not so easily interpreted in terms of the world of sense. But the philosophical problem of the transfer is the same.

Whatever the form of the picture, the hard-pressed physicist of to-day remains on firm ground if he refuses to confuse the concept—the world-picture—with the percept; if, making this distinction, he studies the question of the reality underlying phenomena as philosopher rather than as physicist; if he is as ready to discard outworn models as ever Maxwell was.

There is no finality in these matters, and solutions of these difficulties are solutions for a day; but it is interesting and heartening to know that Planck, the initiator of the movement which has revolutionized physical thought, has, a generation later, pointed a way to a resolution of the fundamental doubts and difficulties which his genius has raised.

. . . . .

Of recent years the British Association has concerned itself more and more with a study of the repercussions of the advancement of science on the fabric of our society. Never in the history of mankind have more powerful weapons for good and for evil been placed in the hands of the community as a direct result of the growth of scientific knowledge; and never has it been more necessary for the scientist to develop some awareness of the effects of his activities on the well-being of that community of which he himself is a responsible member.

We are most of us ready enough to discuss the "Impact of Science on Society", so long as we restrict ourselves to an enumeration of the benefits which science has bestowed upon mankind; and on occasion we may make a rather snobbish distinction between cultural and vocational values. But we have to remember actively that there are dysgenic applications of scientific knowledge, and if the scientist claims, as he rightly does, that place in the counsels of the nation which the importance of his work warrants, he must cease his worship of what Prof. L. Hogben calls the "Idol of Purity", must be prepared to discuss all the

social implications of his work and to educate himself, as well as his less fortunate brethren trained in the humanity schools, in a knowledge of these implications.

The British Association is peculiarly fitted to develop and discuss such knowledge ; in Section A we have made a beginning, but we have as yet touched on but few of these interactions. Our steps are naturally at first a little halting, but with increasing knowledge there will come, I trust, an increased power in elucidating those complex and difficult social problems which the astonishing developments of the last generation have forced on the civilized world.

Science and the Poultry Industry

THE claim of the poultry industry to rank as the third largest branch of British agriculture, when judged by the value of its output, will scarcely be questioned by the visitor to Blackpool for the recent meetings of the British Association. Over the greater part of the County Palatine through which he travelled, the fortunes of farming are based largely upon cows, poultry and pigs, mainly in the order given, whilst the more immediate hinterland of Blackpool is thickly studded with specialist poultry farms. On arrival he would not have been surprised, therefore, to find from his programme that two sections of the Association had thought it worth while to devote a whole afternoon to a joint session for the discussion of problems of the poultry industry, and that further, provision had been made for an external lecture at a rural centre, Poulton-le-Fylde, on the same subject.

For this latter purpose no choice could have been happier than that of Mr. Percy A. Francis, the Poultry Commissioner of the Ministry of Agriculture, who combines unique opportunities of observing the progress of the application of the various sciences to the practice of poultry husbandry with a flair for the exposition in simple terms of his observations that is widely appreciated throughout the industry.

Mr. Francis' survey of the applications of science to the poultry industry necessarily covered a wide field, since in no branch of livestock husbandry are the needs of scientific guidance so varied as in the poultry industry of to-day, with its systems ranging between the two extremes of the open pasture and the intensive 'battery'. At every stage—mating, incubation, rearing, laying, fattening—and in every phase of management—feeding, housing, hygiene, disease control—the keys to success have scientific wards, and the ultimate result is largely affected by the degree to which fundamental scientific postulates have been respected or ignored.

In view of the popular conception of the farmer as being too slowly responsive to the aid of science, it will come as a surprise to many to learn that Mr. Francis is inclined to suggest that some part of the present troubles of the industry on its production side may be traceable to over-haste and ill-informed zeal on the part of the poultry farmer in the incorporation of scientific discoveries into his practice. That there is substance in this suggestion can scarcely be doubted. In the application of new ideas to the development and management of the animal, an immediate improvement can only be accepted as desirable if it is not offset by an ultimate disadvantage of more serious import. Where the animal is used as a breeder, this disadvantage may not be evident until the third or fourth generation or even later. With an animal that grows and multiplies slowly, like the bovine or the human being, the deterioration may indeed cover so long a period of years as to escape detection unless the most careful and prolonged records are kept ; but with a species that grows and multiplies so rapidly as the fowl, the penalty is likely to fall more swiftly, and moreover to be far more widespread in its incidence.

For any errors committed by the poultryman in this respect, the scientific investigator must accept a share of blame, in that all too often he has not made sufficiently clear to the layman that his new discovery, though the latest, is almost certainly not the last word on the subject, and therefore does not justify the poultryman in dissolving completely the partnership with Nature, which hitherto has helped to make good the defects of the combined knowledge of farmer and scientific adviser.

Nowhere has the great advance in our knowledge of animal nutrition furnished by the discovery of vitamins and the study of mineral requirements been more strikingly exemplified than on the poultry farm ; nowhere has the incompleteness of our extended knowledge been more clearly demonstrated.

The major problem with which the industry on its production side is now faced is that of the rising rate of mortality amongst adult stock. There can

be little doubt that this is in part only a manifestation of the general tendency for increasing loss to occur from diseases and other causes when a population is allowed to grow very rapidly without the coincident development of an efficient 'public health' service. The major causes must probably, however, be looked for in other directions, since the great increase in the poultry population between 1918 and 1928 was not accompanied by any serious rise of mortality. Some are inclined to look upon the present troubles of the industry as the harvest of seed sown in that earlier boom period, when possibly the industry expanded faster than its capacity to supply itself with sound breeding stock ; others place the major blame upon excessive resort to 'intensive' methods—too much science ! Still others find a partial explanation in the all too easy dissemination of stock from uncontrolled breeding centres. Wherever the cause may lie, be it in breeding, incubation, management, disease control, or any other part of the field of the poultryman's activities, the need for a combined attack upon the problem is now clamant. Practice alone is unlikely to prove capable of finding a solution ; to the scientific investigator, a vast field of service is open in which the rewards, both to the individual and to the nation, are great and certain. C. C.

Obituary

Prof. R. C. J. Howland

RAYMOND CLARENCE JAMES HOWLAND was born in Fulham on June 5, 1896, and was educated at Latymer Upper School, Hammersmith (1907–15). In December 1914 he won an open scholarship at Emmanuel College, Cambridge, and went into residence in October 1915. After two terms, an attempt to join the O.T.C. having failed on account of defective eyesight, he nevertheless succeeded in enlisting as a gunner in the R.G.A. in March 1916, went to France and served through the rest of the War, returning to Cambridge at the beginning of the Easter term 1919. Although he obtained a first class in Part I of the Mathematical Tripos and was a wrangler in 1920, the handicap due to the interruption of his studies by the War prevented him from taking Schedule B, and debarred him from opportunities which should normally have been open to one of his mathematical ability. In consequence, he went down from Cambridge after taking his degree in 1920 and spent a year in school-teaching at Berkhamsted.

While in Cambridge, however, Howland had prepared for the London external degree, and took his B.Sc. in 1921 with first class honours ; this was followed later by the M.Sc. (1922) and by the D.Sc. (1930).

Fortunately, the openings not available to him in Cambridge were found elsewhere, and, in September 1921, Howland was appointed lecturer at the City and Guilds Engineering College, where he remained for two years. It was there, working under the influence of Prof. H. Levy, that he completed his first piece of mathematical research on "Vortex Motion behind a Circular Cylinder", published in the *Journal of the Royal Aeronautical Society* (1925). His first work to be actually published, however, was a paper on "Transverse Oscillations in Girders" (Institution of Civil Engineers, 1924).

By this time, Howland had obtained (October 1923) a senior lectureship at University College, London, where, although more specially in charge of the teaching to engineering students, he shared in the general work of the Mathematics Department. That he found the atmosphere congenial is shown by the fact that, during the eight years he was at University College, he produced no less than eleven papers, some of outstanding importance.

Howland's scientific interests were almost exclusively directed to problems of classical mechanics, particularly hydrodynamics and elasticity, with engineering applications. Several of his papers deal with rotating shafts, a subject to which he made serious contributions. Here and there we find papers, for example, on determinantal equations and on harmonic and biharmonic periodic functions, which prove that his abilities would have found scope equally on the side of pure mathematics. The work for which he will be best remembered, however, is his solution for an elastic strip of finite width with one or more circular holes, to which he devoted a series of papers in the *Transactions* and *Proceedings of the Royal Society*, either alone or with co-workers. His last paper on this subject was published in 1935, but the fundamental step, namely, the discovery that he could evaluate the troublesome double integrals occurring in the investigation by changing the order of integration, will be found in the first paper of the set (*Proc. Roy. Soc.*, A, **124** ; 1929).

Shortly after publishing this, Howland was appointed (October 1931) to the chair of mathematics at University College, Southampton. There he threw himself into the work with his accustomed energy. He had the rare gift of inspiring others to do research, and when he died he had developed a flourishing mathematical school, which he hoped would deal successfully with the problems of local industries, such as shipbuilding and aircraft construction. He was taken ill somewhat suddenly, while travelling in Wales, and died on August 16 of this year. His premature death at the age of forty years not only is a cruel blow to his family

and his many friends, but also deprives modern engineering of one of its most able and sympathetic mathematical helpers, one who would undoubtedly have made further notable advances in the science of applied mechanics.

As a man, Howland was of a modest and retiring disposition, and it was almost impossible to get him to talk about himself. Behind his reserve, however, lay many wide and human sympathies. In his undergraduate days he was constantly writing both prose and verse, and the choice between literature and mathematics hung for some time in the balance. He was a keen musician and took a full share in musical activities at Southampton. The subjects of various addresses he gave to more popular audiences, on "The Mystery of Number", "Mathematical Wit and Humour" and "Greek Mathematics" are enough to indicate the catholicity of his interests, even in the mathematical field. He married, on November 10, 1923, Lucy Jane Bullock, and his happy life at home contributed in no small measure to the full development of his scientific powers. L. N. G. F.

Prof. Alexander Larmor

THE death, on October 10, of Alexander Larmor, emeritus professor of natural philosophy at Magee College, Londonderry, has removed one who rendered very valuable services to scientific education in Northern Ireland. His published work, though important, gives a very inadequate idea of his powers of mind and his wide knowledge; his friends and correspondents know that, if he wrote comparatively little, he thought deeply on the subjects which interested him.

Larmor's first paper, published in the *Quarterly Journal of Mathematics* in 1886, was on the geometrical theory of perspective, and his last, which appeared in 1933, treated of the FitzGerald contraction. These titles indicate the early and the later interests of a man who, at the beginning, studied under Purser and Everett at Queen's College, Belfast, and who took both the Mathematical and the Natural Science Tripos before becoming fellow of Clare College, Cambridge. He began by working at pure geometry; a taste for this subject and great expertness in it were, in his day, imparted to mathematically gifted boys in Irish schools. His most important geometrical paper, contributed to the London Mathematical Society in 1892, was on the contacts of systems of circles. In later years he became absorbed in the fundamental problems of space and time; he kept himself abreast of recent speculations in this region, and brought to them a mind philosophical and acutely critical.

During his tenure of his chair at Londonderry, Larmor gave himself with his whole heart to the work of teaching and administration, and won the regard and gratitude of pupils and colleagues alike. His lectures were admirable, his sympathetic interest in his students unfailing. He took his full share in the politics of the college in a critical period in its history, and helped greatly in the solution of its difficulties.

Larmor was quiet and reserved in manner, but his obvious sincerity and friendliness exercised a strong attraction upon those who had the privilege of knowing him. To younger men, in particular, he was continually showing kindness, and very many will feel for him life-long affection and gratitude.

W. B. M.

Prof. L. M. Ugolini

WE regret to record the death of Prof. Luigi M. Ugolini, the well-known Italian archæologist, which took place at Bologna recently at the age of forty years.

Luigi Ugolini was born at Bertinoro in Romagna and served in the Alpini during the Great War, being wounded and gaining a bronze medal for valour. After the War he travelled extensively in Europe, Egypt, Roman Africa and the East in the pursuit of his archæological studies. His best known work was connected with the excavation of archæological sites at Fernice and Butrinto in Albania, where he brought to light a number of Greek and Roman antiquities. He had already published three volumes on his researches, and other material was in course of preparation. He was also the author of a work on the prehistoric antiquities of Malta. Recently he had been appointed to a chair in the University of Rome.

Prof. Victor Grignard

PROF. CH. COURTOT, of Nancy, has given an account (*Bull. Soc. Chim.*, **3**, 1433; 1936) of the life and work of Prof. Grignard, Nobel Laureate in 1912, who was best known for his researches on the use of organo-magnesium compounds in synthetic chemistry. Born at Cherbourg in 1871, professor of organic chemistry at Nancy in 1910 and of general chemistry at Lyons in 1919, Grignard carried out a large number of investigations in organic chemistry: Prof. Courtot gives the titles of 163 publications by him and his pupils. During the Great War, he rendered valuable services and was made a member of the Legion of Honour. He was elected an honorary fellow of the Chemical Society in 1920. Shortly before his death on December 13, 1935, Grignard commenced a large treatise on organic chemistry, the first two volumes of which appeared during his lifetime.

We regret to announce the following deaths:

Mr. W. J. Blenheim, American traffic manager of the Western Union Cable system, a pioneer of radio research, on October 29, aged fifty-eight years.

Prof. A. Bömer, emeritus professor of applied chemistry in the University of Münster, and editor of the *Zeitschrift für Untersuchung der Lebensmittel*, aged sixty-nine years.

Prof. T. M. Lowry, C.B.E., F.R.S., professor of physical chemistry in the University of Cambridge, on November 2, aged sixty-two years.

Dr. Sheffield H. M. Neave, known for his work in 1906–7 on sleeping sickness, on October 24, aged eighty-three years.

News and Views

The Nobel Laureates in Medicine

THE Nobel prize for medicine for 1936 is divided between Sir Henry Dale and Prof. Otto Loewi. Sir Henry Dale must have had more influence on medical research than anyone else alive to-day. In the years before the Great War, the Wellcome Physiological Research Laboratories, with him as director, were making discoveries such as had never before been made by a laboratory connected with a pharmaceutical firm. More recently, the National Institute for Medical Research has grown under his guidance until it has become the leading centre for medical research in Great Britain, if not in the world. Sir Henry has been largely responsible for the success of the Commission of the League of Nations on Biological Standards, and it is because of him that a large proportion of the International Biological Standard Preparations are kept in Great Britain. He has been secretary of the Royal Society, and a member of the General Medical Council and numerous committees, but his influence has extended over a much wider field than that covered by these public activities. For many years, he has been consulted, with affectionate respect, by people from all over the world, on questions ranging from general policy to experimental detail. Among all these activities, he has found time to make important discoveries in many fields. He has shown an unusual prescience in working out problems which must have seemed trivial at the time, but have since turned out to be fundamental. Prof. O. Loewi's direct influence has covered a narrower field. Working with simple apparatus, for many years now in Graz, he has shown an uncanny genius for paradoxical discoveries which were not at first believed, but were later confirmed and extended by other, and more elaborate, methods, and formed the basis of one of the most interesting fields of scientific advance. His work has touched many problems, and he is one of the best known and most beloved of German-speaking pharmacologists.

Transmission of Nervous Impulses

THE Nobel prize has been awarded to these two men of science for work on the chemical transmission of nervous impulses. It was known that the effects produced by stimulating sympathetic nerves were also produced by adrenaline, and that the effects of stimulating the vagus were also produced by muscarine and various other drugs. Elliott had hinted, in 1904, at the possibility that sympathetic nerves might produce their effects by actually liberating adrenaline, and Dixon and also Howell had tried to show that some substance was liberated by vagus nerve endings. Dale found that extracts of ergot contained a substance like muscarine, but unstable. This substance turned out to be acetylcholine, and in 1914 Dale, realizing its possible importance in connexion with the vagus, made a detailed study of its effects in the body, in which he showed that it not only reproduced the effects of muscarine, but also those of nicotine. In 1921 Loewi published the first evidence that nerve endings liberate active substances. Under appropriate conditions, the vagus and sympathetic nerves to a frog's heart were shown to liberate two substances, detected by their action on a second heart, and called by Loewi *vagusstoff* and *acceleransstoff*. A dozen papers from Loewi's laboratory answered criticisms of this work and filled in details.

Acetylcholine and Adrenaline

ALL the facts were compatible with the view that the two substances detected in this work were acetylcholine and adrenaline, but Loewi was too cautious to jump to this conclusion. In 1929 Dale and Dudley, working with large-scale apparatus, isolated acetylcholine for the first time from animal tissues, and came to the conclusion that *vagusstoff* could now be definitely identified as acetylcholine. New evidence has justified this conclusion. The pharmacological methods for identifying small quantities of acetylcholine were improved in Dale's laboratory until it was possible to distinguish acetylcholine from such nearly related substances as propionylcholine, and, with these improved methods, it was shown that a substance which could be definitely identified as acetylcholine was liberated, not only by nerves with muscarine-actions, but also by nerves with nicotine-actions. This year, Loewi, working with a method developed in Dale's laboratory, has obtained evidence which enabled him to identify *acceleransstoff* as adrenaline. Though many have worked in this field, these two men have thus obtained all the vital evidence for the modern view that most, if not all, mammalian motor nerves produce their effects by the local liberation of either acetylcholine or adrenaline.

Dr. W. T. Calman, C.B., F.R.S.

THE retirement, at the end of this year, of Dr. W. T. Calman from the keepership of zoology in the British Museum (Natural History) will deprive the Museum and its visitors of the official services of a distinguished carcinologist. Dr. Calman went to the Museum in 1904 from Dundee, where he had graduated and had been assistant lecturer and demonstrator in zoology in the University College. In 1921, he was appointed assistant keeper of zoology at the Museum, and it was in that year that he was elected a fellow of the Royal Society. In 1927, he succeeded Dr. Tate Regan in the keepership. In 1930, he was president of Section D (Zoology) of the British Association, and he is now president of the Linnean Society of London. Dr. Calman's services to carcinology are well known to all zoologists. His morpho-

logical studies are at once shrewd and sound, and the same qualities of insight and judgment are combined with accuracy in his extensive contributions to the systematics of the Crustacea. His volume on this class in Lankester's "Treatise on Zoology" reveals the width of his erudition and is still indispensable to all students of the Crustacea. Dr. Calman's services to zoology have, of course, not been limited to the group in which he has specialized. His address to Section D revealed his interest in the contribution of taxonomy to the greatest zoological problems, and his work at the Museum has shown grasp of and sympathy with the study of all parts of the animal kingdom. In retiring, Dr. Calman takes with him the best wishes of all those to whom his friendly help has been extended, and their hope for much further contribution from him to his science. Mr. M. A. C. Hinton, assistant keeper of zoology in the Museum, will succeed Dr. Calman.

Opening of B.B.C. Television Service

ON Monday, November 2, the high definition television service of the British Broadcasting Corporation was officially inaugurated by Major the Right Hon. G. C. Tryon, H.M. Postmaster-General. This event marks the end of the first experimental period of the television service from the Alexandra Palace, which began during the radio exhibition at Olympia last August. During this experimental period considerable progress was made in the technique of transmitting both direct scenes and cinematograph films, using alternately the Baird and the Marconi-E.M.I. systems of transmission. During the opening ceremony, the Postmaster-General and others had to address themselves not only to listeners but also to viewers within a radius of some 25 miles. As reported in *The Times*, Mr. R. C. Norman, chairman of the B.B.C., was the first to use the word 'viewers' in its new meaning on this occasion. He recalled the fact that almost exactly fourteen years ago, the British Broadcasting Company, as it was then called, transmitted its first broadcasting programme from Marconi House. Following the formal speeches, Monday's programme included a variety item and an excerpt from British Movietone news. As Mr. Norman pointed out, this simple ceremony and programme may possibly seem rather primitive a few years hence to those who are able to recall it; at the present time, however, there is cause for satisfaction on the part of those responsible for the development of this new technique in radio broadcasting.

The Steam Locomotive

AT a meeting of the Institution of Mechanical Engineers on October 23, Sir H. Nigel Gresley was installed as president and delivered an address in which he took, as his main theme, the recent developments in steam locomotives. Forty years ago, the late Mr. Samuel Johnson, in the same position, gave a comprehensive address on the mechanical equipment of British railways, and Sir Nigel pointed out that at that time there were no British locomotives weighing, with tender, 100 tons, no engine with a higher steam pressure than 175 lb. per sq. in., none with a grate area exceeding 27 sq. ft. and no express engine with a higher tractive effort than 19,400 lb. To-day, weights of 165 tons, steam pressures of 250 lb. per sq. in., grate areas of 50 sq. ft. and tractive efforts of more than 40,000 lb. have been attained in Great Britain. In these forty years, the power of British locomotives has increased by a hundred per cent, and the remarkable fact is that these increases have been effected within the limits of the standard track and the even more restrictive limits of the British loading gauge. On American and Continental railways having the same 4 ft. 8½ in. track, locomotives can be built so much higher and wider that engines of double the weight and power of the most modern English engines are quite common. To show the present relative position of steam, Diesel and electric methods of propulsion, numerous figures were given of locomotives and their performances in service, in particular those relating to the *Flying Hamburger*. After prolonged trials, this train was put into operation between Hamburg and Berlin in May 1933. It consists of two articulated coaches on three bogies, is driven by two Maybach 410 h.p. Diesel engines directly coupled to electric generators, and does the journey at an average speed of 77·4 m.p.h. Its smooth running over long distances at a speed of 100 m.p.h. suggested an inquiry as to the possibility of experimenting with extra high speed travel on the London and North Eastern Railway in Great Britain.

THE curves, gradients and speed restrictions on the 268-mile line from King's Cross to Newcastle constitute a more difficult problem than that of the Berlin-Hamburg route, and the makers of the Diesel-electric train estimated that the time required would be 4 hours 15½ min. on the down journey and 4 hours 17 min. up. On the other hand, it was ascertained that a steam locomotive of the "Pacific" type could accomplish it in four hours, and so it was that *The Silver Jubilee* train came to be designed. The engine was made sufficiently powerful to maintain a good speed on the up gradients, for the saving of time in increasing speed from 60 to 90 m.p.h. on a downhill run of 15 miles is only 5 minutes, whereas by maintaining 60 m.p.h. instead of dropping to 30 on the uphill run, 15 minutes are gained. This locomotive exerts a total of 1,750 h.p. when taking a rising gradient of 1 in 200 at 80 m.p.h. It was also mentioned that scale models of the stream-lined engine of *The Silver Jubilee* and of the ordinary "Pacific" type have been under test at the National Physical Laboratory to determine the head-on wind resistances in each case. The horse-power required to overcome these wind resistances has been found to vary from 56·39 and 97·21 respectively at 60 m.p.h. to 881·48 and 1,520·8 at 120 m.p.h., and a remarkable result indicated by the table of figures given is that, within these limits of speed, the saving of power effected by stream-lining is a practically constant proportion, namely 42·1 per cent.

Development of Transport

SIR ALEXANDER GIBB devoted the main part of his presidential address to the Institution of Civil Engineers, delivered on November 3, to an account of some of the works of civilization for which engineers and engineering—in the widest sense—have been responsible. Dealing first with means of transport, he said that the age of roads has now returned. More than 1,000,000 miles of modern roads serve the Empire; that this is still only the beginning is clear from the fact that in Kenya, out of 10,500 miles, only 723 have a metalled surface, the remainder being earth-roads impassable after heavy rain, and in the 370,000 square miles of Nigeria, more than half the 15,000 miles of road are fair-weather roads only. What is required is road planning on really Imperial lines, and the social and political effects would be tremendous. Railway construction in the Empire dated from the middle of the last century. In 1850 Canada had 66 miles of railway; she has now 43,000 miles. With the railways came the steamship era. While the commercial application of the aeroplane has not yet been developed very far, Sir Alexander mentioned that it was almost wholly by air transport that the New Guinea goldfields and various gold and copper mines in northern Canada were opened up. In New Guinea, all the machinery and parts for two large dredgers and a hydro-electric plant of several thousand horse-power were carried wholly by aeroplane over a range of mountains 5,000 ft. high into the interior, and then assembled and put to work within a year.

Engineers and Empire Development

ENGINEERING, or turning to practical account the discoveries of science, Sir Alexander said, is the foundation of civilization. In his opinion, the opportunities of the future are vastly greater than any that the past offered, but he regards with some anxiety the years to come. The machine sometimes seems to be taking control; inventions and developments succeed one another with bewildering speed, and there seems to be no limit to the possible results of uncontrolled and misapplied ingenuity. Engineering provides directly or indirectly the livelihood of about a seventh of the working population of Great Britain. To-day is an age of ever-increasing specialization, and it has inevitably resulted in engineering being split up into many different categories and groups. If the great problems of the future are to be adequately dealt with, an attempt should be made to co ordinate and unite engineering activities in the broadest sense. The Institution of Civil Engineers is taking steps in this matter, and useful work has already been done in the wider question of co-operation with engineering institutions. Sir Alexander thinks that one broad policy should inspire and guide all classes of engineers; there might then arise a body of engineering opinion so weighty, so sane, that it would prevent waste of energy and misplaced enterprise, and would inevitably command attention in the politics, administration and life of Great Britain and the Empire.

Kincardine-on-Forth Bridge

THE Kincardine-on-Forth Bridge which was opened to traffic on October 29 will be a great boon to motorists. Hitherto, traffic from Edinburgh to the north bank of the Forth had to cross either by the ferry at Queensferry or by the bridge at Stirling twenty-five miles to the west. The new road bridge is situated nine miles down stream from Stirling. The bridge is half a mile long, and its most interesting feature is the electrically operated swing span in the centre. This span, which rotates on a central pier, weighs 1,600 tons and has a length of 364 ft.—probably the longest span of this type in the world. It provides two clear openings for shipping each 150 ft. wide. A roadway 30 ft. wide with two 5-ft. footpaths goes over the bridge. The whole of the equipment is controlled from a cabin at the top of the span. The saving in mileage between Edinburgh and Dunfermline by this bridge amounts to 20 miles. The cost of the bridge was £350,000; the consulting engineers are Sir Alexander Gibb and Partners.

THE turning gear of the swing span of the new bridge is driven by two fifty horse-power motors, but only about a fifth of the full power is required. The main position indicator on the control desk gives an alignment with an accuracy not greater than a few inches. But an inaccuracy so large as this would prevent the wedges and bolts being shot. To overcome this difficulty, two independent aligning systems have been installed, one employing photo-electric cells and the other using a target sight lighting principle. As the end of the swing span approaches its aligning position, the first photo-cell passes across a beam of light. This causes one of three lamps on the control desk to light up and a bell to give one stroke. As the span continues to move, the photo-cell crosses other light beams giving a total of three distinct light and sound warning signals. When another photo-cell arrives opposite a narrow slot, the middle lamp on the control desk indicates correct alignment.

The Heat Engine in the Seventeenth Century

IT is generally known that Newcomen was the first to produce a practical cylinder and piston steam engine, but there is a singular lack of evidence to show where he obtained his ideas. Various statements, some of them quite unsubstantiated, about the matter have been made, but little is known with certainty. No one has examined the subject with greater care than Mr. Rhys Jenkins, who at a meeting of the Newcomen Society on October 21 read a paper entitled "The Heat Engine Idea in the Seventeenth Century". In this he impartially reviewed some of his own previous views and endeavoured to trace how the idea of applying heat for motive power might have been handed on from one projector to another in the course of the period 1612–1712. In turn, he referred to the writings and experiments of de Caus, David Ramsay, the Marquis of Worcester, Morland, Papin and Savery. To Papin certainly appears to belong the honour of producing a vacuum

under a piston in a vertical open-top cylinder by the condensation of steam, and it may be Newcomen read a review of a book by Papin contained in the *Philosophical Transactions* of March 1697. Mr. Jenkins placed no credence on the story that Newcomen had been in correspondence with Hooke, as stated by Robison in the third edition of the "Encyclopaedia Britannica", and this story must be omitted from the history of the steam engine, at any rate until documentary evidence is forthcoming.

Domestic Lighting

THE summer school of electrical housecraft recently paid a visit to the Lighting Service Bureau of the Electric Lamp Manufacturers' Association. Mr. W. J. Jones laid stress on the need for adequate light in the home for reading and for carrying out domestic tasks. Practical demonstrations were given to prove his statements. He showed how good lighting helps the eye to see quickly, and hence under favourable conditions a task can be performed with greater accuracy and in less time. When a gramophone turntable with a disk of white cardboard marked by two intersecting lines is made to revolve, its speed seems to increase as the amount of light thrown on the disk is reduced. Actually the speed is kept constant, but so effective is the maximum illumination in reducing the apparent speed of the disk that it is difficult to believe that the speed keeps constant. When the disk is brightly lit, the eye has little difficulty in following the rotation of the lines, whereas when badly lit a confused whirl only is seen. The absorption power of decorations was demonstrated and the importance of using extra light to counteract the effects of a dark colour scheme or of decorations was insisted on. A talking film entitled the "Science of Seeing" has been prepared by the Bureau for loan to schools, etc. During his lecture, Mr. Jones asked his audience to choose the amount of light for the most comfortable seeing conditions in the lecture theatre. This was done by raising and lowering the lighting. Individual members chose illuminations lying between 20 and 75 foot-candles.

Factors affecting Freedom of the Press

FOLLOWING on the broadsheet on the state of the press in Great Britain, issued by Political and Economic Planning in 1935, the Press group of P.E.P. has now issued a further broadcast on the freedom of the press. Besides the various legal factors, such as the law of libel, which restrict publication in the press, there are other equally potent influences which may act in restraint of publication, such as advertizing influence, the private policy of a proprietor, or the pressure of public or semi-public bodies may be exerted in various ways which make it more and more difficult to voice emphatically the grievance of an individual or group against authority and monopoly. While absolute freedom of the press is neither possible nor desirable, there are strong arguments for keeping restrictions and external pressure of every kind to a minimum. Moreover, the selection or rejection of news for a newspaper is still mainly determined not by external influences, however powerful, but by the character and outlook of journalists. Where they are content to follow the line of least resistance, giving prominence to trivialities, and evading or ignoring important subjects and points of view that are unpopular or likely to arouse powerful opposition, the control of the press will in fact be determined by the barriers erected against free discussion, with fatal results. Bad journalism begins by driving out good and may end by causing the imposition of restrictions so severe that good, critical, informed and independent journalism is impossible. On the other hand, independent, courageous journalism creates and commands the admiration of independent and courageous people who are powerful enough to support it and defend it. The fate of the press is bound up with the fate of democracy, and in any type of State the press will have to fight harder to justify its existence against competition and encroachments of many kinds.

Archæology in Indo-China

No little success has been achieved by the first two expeditions of archæological exploration conducted by the Greater Indian Research Committee. This Committee was founded in 1934 under the chairmanship of Sir Francis Younghusband with the object of throwing light by field exploration on Indian cultural and colonial expansion throughout south-eastern Asia. An account of the results obtained up to the present is given by Dr. H. G. Quaritch Wales, the field director, in *Discovery* of November. The first expedition began work at Takuapa on the west coast of peninsular Siam. This has been identified with the Takola Mart of Ptolemy. Here the archæological evidence has demonstrated the existence of a considerable settlement of Siva worshippers of South Indian affinities, which flourished from the fourth to the eighth or ninth centuries of our era, and was frequented by Chinese and Islamic traders. Further, a line of communication with the west coast has been traced to the Bay of Bandon, where excavations have been carried out on the site of the ancient city of Chaiya, apparently the capital of a great Indianized empire. Even more important results were obtained by an expedition to a site in eastern central Siam, where in the remote Pasak valley in the vestiges of a city were discovered relics of the vanished culture of the great Fu-nan Empire, of which this had been an outlying emporium on the trade route to the Menam valley. This culture was overwhelmed and completely destroyed by the rise of the Kmers in the sixth century A.D. Here the most important discovery was that of an Indian brick temple, which is the earliest known example of Indian colonial architecture. Previous to this discovery, all early Indian colonial temples were thought to have been built of wood. Several examples of sculpture were also found of pure Gupta style.

The Earliest Printed Book on the Magnet

THE annotated catalogues of antiquarian booksellers who deal especially in old scientific books always make interesting and instructive reading to the student of the history of science. Sometimes

these catalogues form the medium for the first announcement of bibliographical discoveries of importance. A case in point is afforded by a catalogue (No. 73) recently issued by Messrs. Davis and Orioli, of 37 Museum Street, London, W.C.1. In this list, there is offered for sale a book that the vendors claim to be the hitherto undescribed first printed text of Petrus Peregrinus's treatise "De Magnete". The book in question, a small quarto of six leaves, is entitled "De Virtute Magnetis", and its title page bears the name of Raymundus Lullus as author; but no date or place of printing is indicated. The text is almost identical with that of the edition of Peregrinus's treatise published at Augsburg in 1558, hitherto regarded by bibliographers as the first printed edition. The original "Epistola De Magnete" was written in the thirteenth century, probably in 1269, and several early MSS. copies exist. In a long and interesting note, Messrs. Davis and Orioli give reasons for believing the book they describe to have been printed at Rome by E. M. Silber, not later than the year 1520. They state that, in the past, Peregrinus's treatise has been ascribed both to Raymond Lull and to Roger Bacon, and it is suggested that these authors' names may have been used in a general way during the Renaissance as possible authors of any scientific works. While the 1558 edition is a book of extreme rarity, Messrs. Davis and Orioli have so far only been able to trace one other copy of "De Virtute Magnetis", that in the Bibliothèque Nationale, Paris.

South African Marine Fishes

In a recent descriptive account of "The South African Marine Fishes of Commercial and Angling Importance" by J. M. Marchand (Dept. of Commerce and Industries: Fishery Bulletin No. 2), an attempt is made to provide a handbook for the convenience and use of persons interested in South African sea fishes from the commercial point of view, for sportsmen, and for teachers of biology in South African schools. It is pointed out in the introduction to this work that it is "not intended for the pure scientist, and will be of small if any value to such individuals, due to the limited number of species dealt with, the total lack of classification keys and the brevity of the descriptions". Owing to the brevity of the descriptions, much reliance will have to be placed on the photographic illustrations in making identifications of fishes not already known. This is most unfortunate, for the great majority are so lacking in detail as to be almost useless for this or any other purpose. Some of them, for example, the photograph of *Raia clavata* on p. 52 and of *Arnoglossus pectoralis* on p. 67, are little more than dark blotches on the paper. When, for any reason, detailed drawings cannot be used, simple but accurate outline sketches are infinitely preferable to poorly reproduced photographs for the illustration of a handbook of this kind.

Indian Industrial Publications

The Indian Industrial Research Bureau has issued a bibliography of industrial publications published in India since 1921 (Bulletins of Indian Industrial Research. No. 1: Bibliography of Industrial Publications published in India from 1921. Pp. iii+257. Delhi: Manager of Publications, 1936. 4.6 rupees; 7*s.* 3*d.*). The first part consists of a list of papers arranged chronologically according to publications, which enables readers readily to ascertain the papers published by each local government, government department, society, etc. Publications available in the Library of the Industrial Research Bureau are indicated. The second part is a classified subject bibliography arranged according to the Universal Decimal Classification. The third section of the bibliography comprises a combined alphabetical author and subject index.

Natural History Magazine

The October number of this British Museum publication contains an interesting account of the remounting and preservation of the famous Cranbourne meteorite, the conclusion of a long description of the Museum's East African Expedition, and a paper on vermin, based upon Steele Elliot's Bedfordshire records. We record with regret the concluding paragraph of the number: "The Trustees of the British Museum have decided to cease the publication of the *Natural History Magazine* after the issue of the present number, which completes the fifth volume". The experiment has not been long-lived, and as members of the reading public we should attribute its failure to the price charged for what is essentially Museum advertisement and propaganda, and to the tendency of contributors to forget that lightness of hand as well as solid fact is a necessary ingredient in attractive writing.

Index to the *Geographical Review*

The *Geographical Review* (the quarterly journal of the American Geographical Society) for the ten-year period from 1926 to 1935 contains 7,000 pages of articles, record items, and book reviews, including more than fifty articles on the geographical results of important expeditions, most of them written by the expedition leaders themselves. To make this great mass of geographical material available in organized form, the Society has now prepared an analytical index of 373 pages covering this ten-year period. The price of the index is: unbound, 4.50 dollars; bound, 5.25 dollars. The index to vols. 1–15, 1916–25, of which there are still a limited number of copies available, is offered along with the index to vols. 16–25, at a special price of 8.00 dollars unbound, or 9.50 dollars bound, for the two indexes. These may be obtained from the American Geographical Society, Broadway at 156th Street, New York, N.Y.

Medical Peace Association

A meeting of medical practitioners and other scientific workers to consider the subject of aerial warfare and means of defence against it will be held in the Hastings Hall, British Medical House, on Wednesday, November 25, at 8.30 p.m. The chair will be taken by Dr. E. P. Poulton, and speakers

will include Dr. Stella Churchill, Dr. Robert Edbrooke, Mr. R. Makinnon Wood and Dr. L. A. Rawlings. It is hoped that there will be a full discussion of the whole subject, and particularly of the attitude which the medical profession might reasonably adopt towards it. Information about the Medical Peace Association may be obtained from the Hon. Secretary, Dr. Cecile Booysen, 12 Kent Terrace, N.W.1.

Nutrition in the Colonial Empire

THE Prime Minister has appointed a Committee of the Economic Advisory Council with the following terms of reference: "(1) To survey the present state of knowledge in regard to nutrition in the Colonial Empire in the light of the replies received to the circular dispatch addressed by the Secretary of State for the Colonies on April 18, 1936, to the Officers Administering the Governments of Colonial Dependencies. (2) To advise from time to time as to the measures calculated to promote the discovery and application of knowledge in this field." The Committee is constituted as follows: Earl De La Warr (chairman), Prof. E. P. Cathcart, Mr. G. L. M. Clauson, Dr. Philippa C. Esdaile, Prof. Noel Hall, Dr. J. M. Hamill, Mr. Francis Hemming, Mr. E. M. H. Lloyd, Prof. Edward Mellanby, Sir John Orr, Dr. Audrey Richards, Mr. H. S. Scott, Sir Thomas Stanton, Mr. F. A. Stockdale, Mr. Hans Vischer. The secretaries to the Committee are Mr. D. H. F. Rickett (Economic Advisory Council) and Mr. C. G. Eastwood (Colonial Office).

Announcements

MME. JOLIOT-CURIE has resigned her appointment of Under-Secretary for Scientific Investigation in the French Cabinet to occupy a chair in the Faculty of Natural Science at the Sorbonne, and has been succeeded by Prof. M. Jean Perrin, For.Mem.R.S., known for his work on atomic chemistry, and Nobel prizeman for physics in 1926.

DR. WOLFGANG HEUBNER, professor of pharmacology at the University of Berlin, has been elected an honorary member of the Biological Society of Vienna and of the Imperial Leopold Caroline German Academy of Natural Philosophers at Halle.

PROF. FERDINAND HUEPPE, of Dresden, emeritus professor of hygiene in the German University at Prague, has been awarded the Goethe Medal for Science and Art by the Chancellor of the Reich in recognition of his services in connexion with physical training.

AT the thirty-ninth Congress of the International Law Association for the Protection of the Civilian Population against Modern Warfare, recently held in the Cour de Cassation of the Paris Palais de Justice, a committee was formed to consider the question of the protection of the civilian population against the new engines of warfare, and especially aerial bombardment. The work of the Committee will be carried on in close association with the International Committee of the Red Cross and the International Association for the Protection of Humanity recently founded at Monaco.

ADVISORY LEAFLET No. 272 of the Ministry of Agriculture directs attention to the disease fowl paralysis, which is unfortunately becoming more common. The cause is not known, and no treatment of proved value is available, but the disease can be minimized by removing weak birds, and by not breeding from infected stocks.

CULTIVATION and distillation of peppermint form the subject of Advisory Leaflet No. 98 of the Ministry of Agriculture. Two varieties of this fragrant herb are recognized, namely, black mint, *Mentha piperata* var. *officinalis*, and white mint, *M. piperata* var. *vulgaris*. Harvesting and distilling are described in detail, and the effects of the fungus disease, *Puccinia menthæ*, are considered. Peppermint might be grown with advantage on a larger scale in Great Britain.

THE resumption of work in the technical schools and colleges gives special value to the issue of Foyle's Technical Catalogue (London: W. and G. Foyle, Ltd.) which contains particulars of new and second-hand books on more than 450 subjects coming within the range of applied science.

THE latest catalogue of old scientific books issued by E. P. Goldschmidt and Co., Ltd., of Bond Street, W.1 (No. 40. Old Science and Medicine) includes 216 items, many of great interest, on a variety of subjects, and contains a number of facsimile and other illustrations. Among the books offered for sale are copies of the first edition of Gilbert's "De Magnete", and of an edition of this work printed at Stettin in 1633.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

Assistants, Grade II and III (engineering) in the Admiralty Technical Pool—The Secretary of the Admiralty (C.E. Branch), Whitehall, London, S.W.1 (November 2).

A heating and ventilating engineer in the Directorate of Works and Buildings of the Air Ministry—The Secretary (W.B. 9), Air Ministry, Adastral House, Kingsway, W.C.2 (November 14).

A research assistant in the Department of Oil Engineering and Refining, University of Birmingham—The Secretary (November 18).

A junior lecturer in civil engineering in the University of the Witwatersrand—The Secretary, Office of the High Commissioner for the Union of South Africa, South Africa House, Trafalgar Square, London, W.C.2 (December 2).

Structural engineering assistants in the Designs Branch of the Directorate of Fortifications and Works at the War Office—The Under-Secretary of State (C.5), The War Office, London, S.W.1 (Quote Appts./2).

An acting editor to the Royal Scottish Geographical Society—The Secretary, Synod Hall, Edinburgh.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 804.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Vitamin Nature of Flavones

IN a previous note[1] we reported on the favourable effect of flavones upon the resistance and permeability of the capillary wall in certain pathological conditions.

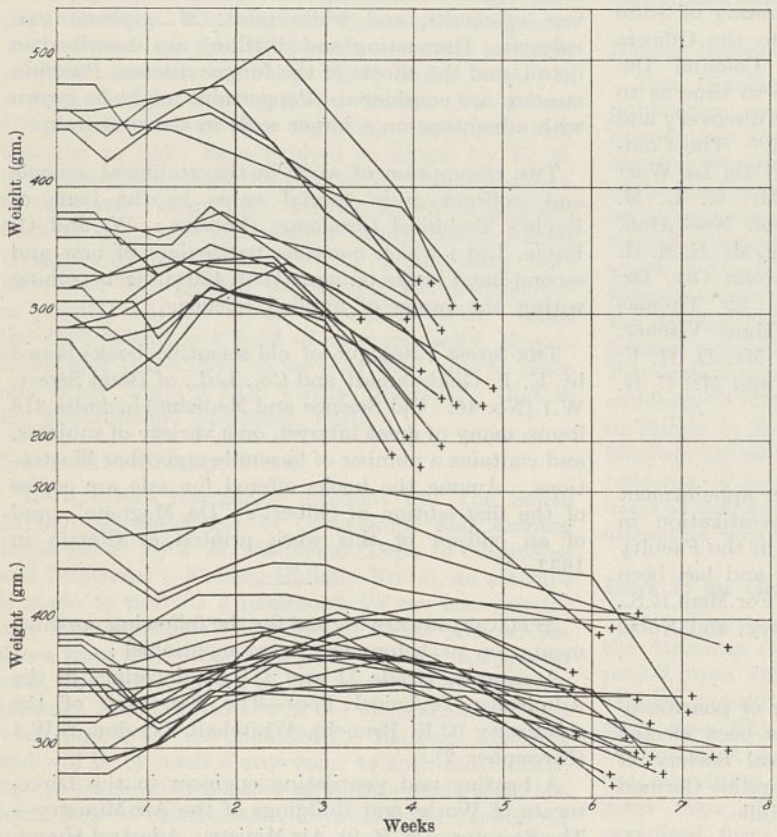

FIG. 1. Weight curves of guinea pigs receiving a scurvy diet without (above) and with (below) the addition of 'Citrin'.

The substances responsible for this activity were tentatively termed 'vitamin P'. The acceptance, however, of the vitamin nature of these dyes depended on the experimental demonstration of the symptoms of deficiency.

Thirty-eight guinea pigs, weighing 280–485 gm., were placed on the Sherman – La Mer – Campbel scurvy diet. The components of the food were autoclaved for one hour and a half at 120° C., ammonia being added to the water of the autoclave. Twenty-one of the animals received 1 mgm. 'Citrin'[2] daily, this substance being the crystalline flavone fraction of lemon juice. A smaller additional group of animals received mixed food.

The weight curves of the animals (17), receiving the scurvy diet only, are represented in the upper part of Fig. 1. The curves of the animals end with death. They show the usual rapid fall after the second week of the experiment, death occurring on average at 28·5 days. The weight declines on the average from 359 gm. to 242 gm.

The data of the second group, receiving 'Citrin', are represented in the lower part of Fig. 1. The administration of flavone was discontinued at the end of the sixth week. Compared with the first group, these animals live distinctly longer, on the average 44 days. At 34-38 days no animal from this group had died, while all animals in the first group were dead. There is also a marked difference in the weight curves, which fail to show the pre-mortal rapid decline, the average weight of 365 gm. falling to 342 gm. only.

Since the food contained no ascorbic acid, the animals could not be expected to live indefinitely. All the animals of both groups showed the typical clinical symptoms of scurvy. On autopsy all the animals showed the typical fragility of bones, looseness of teeth and swelling of joints. There was, however, a very marked difference in the intensity of hæmorrhages in both groups. In our protocols the hæmorrhages were noted, according to their extent, by one, two or three crosses. The relation of the number of crosses given per 100 animals in the first and second group was 212 to 68 for hæmorrhages of the costal joints, 77 to 14 for intestinal hæmorrhages, 224 to 71 for different articular hæmorrhages, and 178 to 33 for hæmorrhages in the muscles. The vitamin P seems thus to have a marked and somewhat specific influence on the capillary system. This agrees with our clinical observations.

A third and smaller group of animals, receiving mixed food, showed normal growth. A preliminary experiment with half the number of animals gave identical results.

These results suggest that experimental scurvy, as commonly known, is a deficiency disease caused by the combined lack of vitamin C and P.

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A. BENTSÁTH.
Institute of Medical Chemistry ST. RUSZNYÁK.
and the Medical Clinic, A. SZENT-GYÖRGYI.
Szeged.

[1] NATURE, **138**, 27 (July 4, 1936).
[2] *Deut. Med. Wochsch.*, Nr. 33, 1325 (1936).

Estimation of Ascorbic Acid (Vitamin C) by Titration

THE chemical determination of ascorbic acid is based upon the high reducing capacity shown by this substance with different organic compounds. One of the best known methods based upon this property is the titration of ascorbic acid with 2 : 6 dichlorphenol indophenol[1], after the removal of interfering substances with mercuric acetate. Others[2] have found that ascorbic acid reacts with methylene blue, and this property was made use of for its estimation. This method appears to be the most satisfactory, because the presence of other reducing substances does not interfere with the reactions linked to certain hydrogen ion concentrations. It has, however, certain disadvantages inherent to its colorimetrical nature. It is on account of this circumstance that I have tried to modify this method of estimation and thus to eliminate possible sources of error.

Several investigators having found that trichloroacetic acid seriously interferes with the stability of ascorbic acid, I have used for its extraction—according to Fujita's method[3]—metaphosphoric acid, which does not react either with methylene blue or with ascorbic acid. Martini and Bonsignore claim that the reaction of methylene blue is specific for vitamin C after a previous treatment of the solution with sodium citrate, sodium bicarbonate and thiosulphate in adequate quantities. These findings have been confirmed. But I have also taken into account the fact that methylene blue can be decolorized by different inorganic compounds. It seemed therefore logical to suppose that after treatment with general agents and exposure to light, the methylene blue remaining might be titrated with the aid of an adequate reducing compound. I have found that titanium trichloride (Merck) is a suitable substance for such purposes. However, as titanium trichloride reacts in certain concentrations with methylene blue (in the same manner as it does with other azo dyestuffs), it was necessary to prepare it in a suitable dilution in order to neutralize its action. I have found that a dilution of 5 in 1,000 answers this purpose. Below this limit no reaction can be observed.

It is important that the titanium trichloride solution should always be prepared freshly and determined against a standard methylene blue solution. The methylene blue solution (Höchst, med.) must be pure and kept cool, and the determination must be made rapidly. It is known that solutions containing ascorbic acid will decolourize the methylene blue added to it. In consequence, a standard methylene blue solution is added to the solution to be examined for its ascorbic acid content, until, after exposure to intense sunlight or to a 300 watt Philip's lamp, the colour of the solution to be titrated changes no more (time of irradiation 30–50 sec.). The quantity of methylene blue added to the solution being known, and knowing also the quantity of titanium trichloride necessary to decolourize the dyestuff remaining, these two data are sufficient to calculate the ascorbic acid content of the medium under investigation. Thus, for example, 1 ml. of methylene blue being equivalent to 0·047 mgm. ascorbic acid and the titanium trichloride content being proportional to the methylene blue concentration, it is easy to calculate the ascorbic acid content of the substance investigated from the quantity of titanium trichloride used to reduce the methylene blue not reacting with ascorbic acid.

Should it be necessary to estimate the oxidized ascorbic acid content of the substance in question, the mercuric acetate method[4] above can be recommended; but care must be taken to remove any hydrogen sulphide, as it reacts with methylene blue. It is therefore absolutely necessary to carry out the reaction in a stream of carbon dioxide. The solution must be slightly acid. This modified method can be used for the estimation of the ascorbic acid content of both vegetable and animal tissues.

IMRE GÁL.
Hungarian Biological Research Institute,
Tihany, Hungary.

[1] H. Tillmans, *Z. Unters. Lebensm.*, **63**, 1; **63**, 241 (1932).
[2] E. Martini and A. Bonsignore, *Biochem. Z.*, **273**, 170 (1934).
[3] A. Fujita, D. and Miyata Iwatake, *Biochem. Z.*, **277**, 293, 296 (1935).
[4] M. van Eekelen and A. Emmerie, *Biochem. J.*, **28**, 268, 1153 (1934).

METHODS for the determination of ascorbic acid have recently been much discussed. Tillmans' method, as modified by Harris and Ray[1], is generally accepted as more specific and simpler than the other methods proposed.

However, the rapid oxidation of ascorbic acid necessitates carrying out the titration in as short a time as possible, if consistent results are to be obtained. We have now found that by cooling the ascorbic acid solution to 0° C., and by *carrying out the titration at this temperature*, it is possible to slow down very appreciably the oxidation, so that a more constant end point is obtained, and time is no longer such a fundamental factor in the results.

A more detailed account of this slight modification of Harris and Ray's method will appear elsewhere, but we think this brief statement of the facts may be of use to those interested in these problems.

HENRI CHEFTEL.
MARIE-LOUISE PIGEAUD.
Laboratoire de Recherches Biologiques,
J. J. Carnaud et Forges de Basse-Indre,
71 Avenue Edouard Vaillant,
Boulogne-Billancourt.

[1] Harris and Ray, *Biochem. J.*, **27**, 303 (1933).

Comparison of Mineral and Biological Potassium in Diet Experiments

DURING the past eighteen months, we have been investigating, by means of diet experiments on mice, the question whether potassium of mineral origin is equivalent to that of biological origin, in view of the possibility that the isotopic constitution may be different. Brewer[1] has recently reported that some of the samples of vegetable potassium tested differed slightly from mineral potassium.

The food utilized consisted of water-extracted maize-meal and casein, yeast extract (rendered potassium poor), cod liver oil, water-extracted agar-agar and a salt mixture. The potassium was added to the salt mixture as a chloride. The 'biological' potassium chloride was prepared from the dry residue of the united extracts of the maize, casein and agar-agar, while KCl (*AR*) was used as a source of 'mineral' potassium. Four groups of 10 or 12 mice were used in each experiment, two serving for testing any difference in the two types of potassium and two serving as controls.

The results so far indicate that a difference in action of the two kinds of potassium exists, at least under certain conditions; but that the matter,

considered as a whole, is rather complex. First, we found that the diet we had chosen was not a complete one: the animals lost weight more or less quickly and finally died. However, the loss of weight, etc., seemed frequently to depend upon the kind of potassium received by the animals. Thus in one experiment, lasting six weeks, the average decrease in weight was delayed among the animals receiving mineral potassium, while among the animals receiving biological potassium a continual fall of the average weight was observed. In another experiment, lasting ten weeks, a similar and more pronounced result was obtained, and in addition it was found that the average duration of life was definitely greater among the animals receiving mineral potassium. A third experiment, also lasting ten weeks, showed, however, no difference in the average decrease in body-weight of the two groups, but it did show a slight difference in the average duration of life in favour of mineral potassium.

While these experiments, which were carried out during the autumn of 1935, winter of 1936 and summer of 1936 respectively, showed that, under the given conditions, mineral potassium was to a varying degree superior to biological potassium in maintaining life, a further experiment of ten weeks duration, carried out during the spring of 1936, showed a contrary result, the average decrease in weight being slower and the average duration of life being definitely greater among the animals receiving biological potassium. Three other experiments, in which the calcium and phosphate content of the food was somewhat lower than before, were carried out, namely, in the spring of 1936, and in the summers of 1935 and 1936. In the first experiment the result was in favour of the mineral potassium, while in the last two it tended to be in favour of the biological potassium. Further investigations are in progress, especially to elucidate the influence of season, and also any possible part played by the calcium or the phosphate content of the food.

A. LASNITZKI.
M. LASNITZKI.
Cancer Research Department,
University, Manchester.
Oct. 9.

[1] Brewer, *J. Amer. Chem. Soc.*, **58**, 365 (1936).

Total Dissociation of Horse Hæmoglobin

THE native hæmoglobin of the horse, in unbuffered dilute salt solutions at the isoelectric point, is totally dissociated into molecules of half the normal molecular weight, when high concentrations of urea (more than 4 *M*), acetamide (6·5 *M*), or formamide (3 *M*) are present in the solution. The sedimentation constant, measured in the Svedberg ultracentrifuge and corrected to its equivalent in pure water at 20°, falls from 4·5 to $3·1 \times 10^{-13}$, and the diffusion constant, measured by the refractometric method of Lamm and Polson[1], rises to $7·8 \times 10^{-7}$, the value characteristic of ovalbumen. The partial specific volume is not appreciably changed.

The tendency of horse hæmoglobulin to dissociate into smaller molecules is noticeable even in ordinary solutions[2] and can be enhanced in various ways[3], but it has not been possible hitherto to effect its total dissociation. The reality of the change in molecular weight is supported by the failure of much higher concentrations of the substances named to produce a further fall in the corrected sedimentation constant. The diffusion constants show no drift with time, although ordinary hæmoglobin solutions, when investigated in the usual way, yield apparently higher diffusion constants which decrease with time, owing to the partial dissociation of the protein by dilution at the boundary. Concentrations of urea and acetamide which are effective in totally dissociating hæmoglobin cause no trace of dissociation with the smaller protein, pepsin; discrepancies, due to large corrections for viscosity and density which must be employed, or to a possible failure of theory in such concentrated solutions, should have affected both proteins equally.

These results confirm, in part, the osmotic pressure measurements of Burk and Greenberg[4], who reported that hæmoglobin and other proteins are split in 6·66 *M* urea. The criticisms of this work offered by Hand[5] cannot be applied to the present experiments, and his denial that hæmoglobin is dissociated is not confirmed.

In contradiction to the report of Burk and Greenberg, it has been shown that the change in molecular weight *is unaccompanied by any evidence of denaturation*. Measurements with the Hartridge reversion spectroscope show that the bands of the CO, O_2, and reduced forms are unchanged; methæmoglobin, and alkaline hæmochromogen prepared from totally dissociated protein, are likewise spectroscopically unchanged, and the process of denaturation is still required for the production of hæmochromogen. The stability of the methæmoglobin, however, diminishes, and it changes within a day (at room temperature) to a substance with a parahæmatin spectrum. This apparent parahæmatin has a number of anomalous properties: addition of alkali fails to change it to hæmochromogen, and reduction by hydrosulphite produces a normal reduced-hæmoglobin spectrum, which is readily converted to the CO or O_2 two-banded forms.

The existence of this 'parahæmatin' casts some doubt on the usual interpretation of parahæmatins as the ferric state of acid hæmochromogens, that is, in this case, denatured methæmoglobin. It seems probable that Burk and Greenberg observed the formation of this anomalous parahæmatin through an intermediate state of methæmoglobin, since their solutions contained oxygen. Without oxygen, solutions of CO-hæmoglobin in 25 per cent urea keep indefinitely. On dialysis of urea solutions, part of the hæmoglobin precipitates irreversibly, but all its properties except its molecular weight (as is the case with the activity of pepsin) are unchanged before the urea is *removed*. Not only spectroscopic observations, but also measurements of the oxygen and carbon monoxide combining capacities, and of the ratios of the affinities to oxygen and carbon monoxide contribute to this conclusion.

The formation of hæmoglobin with a molecular weight similar to that of myoglobin, and presumably containing only two prosthetic groups per molecule, is of interest in view of current theories of the complex equilibrium between normal hæmoglobin and oxygen[6]. Efforts to study this equilibrium in urea solutions have met with experimental obstacles, but measurements of the oxygen-carbon monoxide affinity ratio show that the change in molecular weight has not brought about a resemblance to myoglobin in this respect.

The very great effects of urea and amides on protein solubility are manifested at much lower concentrations than those at which appreciable dissociation

occurs; they are as pronounced with pepsin, which does not dissociate, as with hæmoglobin which does. The specificity of amides for both effects and the repeated occurrence of the amide bond in proteins suggest that the two phenomena may nevertheless have related causes. They do not appear to be related to changes in dielectric constant. Urea and formamide solutions have dielectric constants greater, and acetamide solutions much smaller, than that of water. Glycine solutions, with dielectric constants still higher than those in urea, are without effect on dissociation, and have relatively small influences on solubility.

These measurements were made possible by the facilities provided by Prof. The Svedberg at Uppsala, and by Sir Joseph Barcroft at Cambridge. They owe much to the advice and assistance rendered by Dr. K. O. Pedersen at Uppsala, and by Dr. G. A. Millikan and Prof. D. Keilin at Cambridge. Full details will be published elsewhere.

JACINTO STEINHARDT.
(General Education Board Fellow.)
Institute of Physical Chemistry,
Uppsala.
Oct. 8.

[1] O. Lamm and A. G. Polson, *Biochem. J.*, **30**, 528 (1936).
[2] A. Tiselius and D. Gross, *Koll. Z.*, **66**, 12 (1934).
[3] K. O. Pedersen, unpublished, and NATURE, **138**, 363 (1936).
[4] N. F. Burk and D. M. Greenberg, *J. Biol. Chem.*, **87**, 197 (1930).
[5] D. B. Hand, *J. Biol. Chem.*, **109**, xi (1935).
[6] W. H. Forbes and F. J. W. Roughton, *J. Physiol.*, **71**, 229 (1931).
L. Pauling, *Proc. Nat. Acad. Sci.*, **21**, 186 (1935).

Inhibited Deposition of Stearin from Chilled Olive Oil

WE have observed that the addition of very small amounts of air-blown cacao-butter (Iodine No. = 20) to olive oil permits such oil to remain liquid and free from stearin deposit on storage at temperatures between 2° C. and 4° C. Untreated olive oil in such storage sets solid within 12 hours, whereas we have found the inhibition effect to persist after even four years storage at 2° C. (Fig. 1).

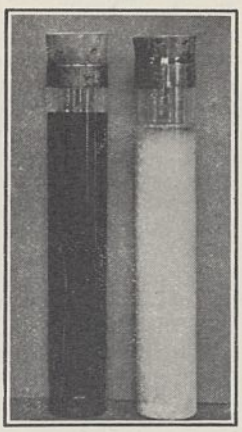


FIG. 1.

The amount of blown cacao-butter required varies from 0·1 to 0·5 per cent, depending on the technique of its oxidation, and the length of time the olive oil is to be stored cool. The inhibition effect is highly specific in that: (*a*) no other blown oil or fat serves so well, and (*b*) protection is not afforded to other oils such as arachis, or cotton-seed.

This inhibition phenomenon has been found to furnish a quantitative guide to the very remarkable property of blown cacao-butter to prevent fat-bloom in stored chocolate, in which respect it is greatly superior to lecithin or other anti-bloom agents.

Our investigations will be fully reported elsewhere.

WILLIAM CLAYTON.
SYDNEY BACK.
ROBERT IAN JOHNSON.
JAMES FREDERICK MORSE.
Research Department,
Crosse and Blackwell, Ltd.,
London, W.1.

Increase of Diamagnetic Susceptibility on the Death of Living Cells

ACCORDING to E. Bauer's theory, the lack of equilibrium in living systems is due to an excited state of the protein molecules of the protoplasm. The maintenance of this state is operated through the process of metabolism, collisions of the second kind between the molecules of the protoplasm and those of the food substance leading to an activation of the latter, and their chemical energy, set free in the reaction, being used to maintain the active, excited state of the molecules of the living substance[1].

If now this active state of the molecules of the living substance consists in an electronic excitation or—what seems more probable—in the existence of free valencies, which on death are saturated within the protein molecule, then the living and dead substance must differ with respect to its magnetic susceptibility, since, owing to the falling out of the paramagnetic component, the resulting diamagnetic susceptibility must increase on death.

Measurements to check this point were carried out by us with the assistance of the magnetic laboratory of the Ural Physico-Technical Institute (formerly at Leningrad, now at Sverdlovsk). They gave a positive result. In the case of yeast and suspensions of bacteria (*B. coli*, *B. proteus*) we found an increase of diamagnetic susceptibility on death amounting to 4 per cent, the maximum possible error not exceeding 0·7 per cent. This result was independent of the way the cells were killed: beating or cooling down with liquid air produced the same effect as spontaneous death. It is important to note that denaturation of native protein did not affect the magnetic susceptibility.

ERWIN BAUER.
A. RASKIN.
Department of General Biology,
All-Union Institute of
Experimental Medicine,
Leningrad.

[1] A detailed presentation of the theory has been given in E. Bauer's "Theoretical Biology" (Russian), 1935. A brief sketch and a few applications in *Biodynamica*, No. 14, 15 (1936).

Nitrogen Losses in Green Plants

A FEATURE of the nitrogen metabolism of plants which has received little attention is the possibility of considerable losses of nitrogen during the process of nitrate reduction. It is generally agreed that this process leads first to the production of nitrites, and the presence of nitrites in plants actively engaged in nitrate reduction has been shown by Eggleton[1]. As plant tissues are normally acid, nitrous acid should be present, and this should combine with mono-amino nitrogen to give elementary nitrogen. It is well known that this reaction is rapid *in vitro*[2]. It has been shown by Irving and Hankinson[3] that *Elodea* produces elementary nitrogen when immersed in solutions containing nitrates and asparagine as a source of amino-nitrogen.

Two examples in which such losses of nitrogen occur have recently been observed by us and studied in some detail. In one of these, pure cultures of *Chlorella vulgaris* growing (in the dark) in a nutrient medium (*p*H 5·8) containing glucose (10 gm. per litre) and sodium nitrate (0·26 gm. per litre), retained in the cells 3·4 mgm. of nitrogen out of 13 mgm.

in each culture flask. The external medium at this time contained only 1·1 mgm. of nitrogen (Kjeldahl-Gunning) of which 0·6 mgm. was nitrate nitrogen. Thus 8·5 mgm. of nitrogen were lost, presumably in elementary form.

Similar losses of nitrogen have been observed when daffodil leaves were floated aseptically on glucose media (3 per cent, buffered by phosphate mixtures to *p*H 5·4) containing an inorganic source of nitrogen such as ammonium or potassium nitrate. Of the nitrogen absorbed from the medium, about half is normally lost, the remainder being retained in the leaves. In contrast, if organic sources of nitrogen (such as asparagine, alanine or urea) are used, the whole of the nitrogen absorbed can be recovered in the leaves. It may be noted that considerable losses of nitrogen are always associated with low amino-nitrogen content of the leaf tissues.

W. H. PEARSALL.
M. C. BILLIMORIA.

Botanical Department,
University, Leeds.
Oct. 20.

[1] *Biochem. J.*, **29**, 1389 (1935).
[2] Van Slyke, *J. Biol. Chem.*, **12**, 375 (1912).
[3] *Biochem. J.*, **3**, 87 (1907).

Route of Migrating Parasites in Ruminants

MR. W. M. WEBSTER, veterinarian of this College, has shown me an adult specimen of the lungworm *Dictyocaulus filaria* that he found in an undamaged condition in the small intestine of a hogget.

This observation, it appears to me, reveals something of the movements of parasites that undergo the lung journey in ruminants.

In the first place, the specimen must have been coughed from the lungs and then swallowed. It does not seem possible that it could have been involved in the process of rumination for, on account of its relatively large size, it would have been crushed The conclusion therefore follows that the worm during its journey to the small intestine could not have spent a period in the rumen.

Perhaps the eggs or larvæ of the various lungworms and other worms, in their passage from the lungs, behave in a similar manner, and proceed directly from the gullet to the reticulum.

J. H. TETLEY.

Zoology Department,
Massey Agricultural College,
Palmerston North,
New Zealand.
Aug. 2.

Resonance Structures of Carbon Dioxide, Carbonyl Sulphide and Carbon Disulphide

BY comparing experimental heats of formation with bond energies derived from compounds without alternative Lewis structures, Pauling and Sherman[1] deduce resonant structures for carbon dioxide, carbonyl sulphide, and carbon disulphide, of the type :

$$:\overset{+}{O}:::C:\overset{\cdot\cdot}{\underset{\cdot\cdot}{O}}:\overset{\cdot\cdot-}{\underset{\cdot\cdot}{}}\rightleftharpoons:\overset{\cdot\cdot-}{\underset{\cdot\cdot}{O}}:C:::\overset{+}{O}:$$

but the impossibility of obtaining a valuation of the bond energies of partially ionic bonds from thermal data does not permit of a more penetrating analysis of the resonance of these compounds along these lines.

Gray and Cruickshank[2] have demonstrated the presence of resonance in certain compounds by considering diamagnetic susceptibilities. As partially ionic bonds can be evaluated magnetically, a greatly increased number of theoretically possible structures can be considered.

The diamagnetic susceptibilities of the above compounds are :

$$CO_2\ -20{\cdot}80^3\ ;\ COS\ -32{\cdot}36\ ;\ CS_2\ -42{\cdot}29,$$

and these experimental susceptibilities can be compared with the theoretically possible states of the molecules and with Pauling's resonance energies.

	E	Reson. E	Susceptibility of $X{=}C{=}X$	Susceptibility of $:\overset{\cdot\cdot-}{\underset{\cdot\cdot}{X}}:C:::\overset{+}{X}:$	Expt. suscept.
CO_2	16·79	1·37 ve.	−2·73	−20·80	−20·80
COS	14·55	0·84 „	−12·31	−38·00 } *	−32·36
				−42·79 }	
CS_2	12·46	0·46 „	−22·54	−59·84	−42·29

* The two states $:\overset{\cdot\cdot-}{\underset{\cdot\cdot}{O}}:C:::\overset{+}{S}:$ and $:\overset{+}{O}:::C:\overset{\cdot\cdot-}{\underset{\cdot\cdot}{S}}:$ do not have identical susceptibilities. All susceptibilities are $\times\ 10^{+6}$.

Neither of the calculated values for the structures O=C=O, O=C=S, S=C=S, agrees with the experimental value, this being what one would expect from the suggestions of Pauling and Sherman, but in the case of carbon dioxide a resonance

$$:\overset{+}{O}:::C:\overset{\cdot\cdot-}{\underset{\cdot\cdot}{O}}:\rightleftharpoons:\overset{\cdot\cdot-}{\underset{\cdot\cdot}{O}}:C:::\overset{+}{O}:$$

would give for the susceptibility −20·80, which is exactly what is found experimentally (−20·80), a convincing demonstration of resonance in the carbon dioxide molecule.

The introduction of one sulphur atom is accompanied by a fall in resonance energy. In carbonyl sulphide two ionic states are possible. Direct resonance between these states gives too high a calculated susceptibility, but the existence of an intermediate state O=C=S enables the experimental value to be accounted for.

$$:\overset{+}{S}:::C:\overset{\cdot\cdot-}{\underset{\cdot\cdot}{O}}:\rightleftharpoons S{=}C{=}O\rightleftharpoons:\overset{\cdot\cdot-}{\underset{\cdot\cdot}{S}}:C:::\overset{+}{O}:$$

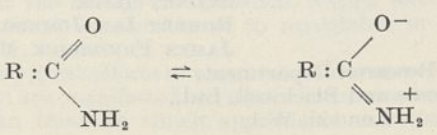
If equal times were spent in these three states, the calculated susceptibility would be −31·02, compared with the experimental value −32·36.

A further fall in resonance energy takes place on passing to carbon disulphide, and in agreement with this, resonance between

$$:\overset{\cdot\cdot-}{\underset{\cdot\cdot}{S}}:C:::\overset{+}{S}:\rightleftharpoons S{=}C{=}S$$

is suggested by the diamagnetic susceptibility of carbon disulphide (calculated −41·19 ; experimental −42·29).

The resonance in amides suggested by Pauling is also confirmed magnetically :



If equal times were spent in each state the calculated susceptibility would agree closely with the experimental.

	Calculated	Experimental
Formamide	−22·39	−21·87
Acetamide	−34·29	−33·75

In thioacetamide, however, there is not the same resonance, as the experimental susceptibility indicated a stable doubly bound structure.

These results show that the study of diamagnetic susceptibilities can be applied to problems involving quantum mechanical resonance, and allowing for relatively small experimental errors, seem to indicate a distinct tendency for molecules to spend non-fractional times in the possible states.

The deduction of the theoretical values for sulphur bonds which were not given by Gray and Cruickshank will be published elsewhere.

ARCHD. CLOW.
J. M. C. THOMPSON.

Department of Chemistry,
University, Aberdeen.
Sept. 28.

[1] Pauling and Sherman, *J. Chem. Phys.*, **1**, 606 (1933).
[2] Gray and Cruickshank, *Trans. Far. Soc.*, **31**, 1491 (1935).
[3] Stoner, "Magnetism and Matter" (Methuen, 1934), p. 274.

Constitution of Phosphorous Acid and the Phosphites

MENZIES[1] and Bär[2] showed that it is possible to obtain Raman spectra with crystal powders in which at least some of the stronger lines of the substances are recorded. I have shown[3] that the technique of obtaining the spectra with powders is vastly improved if a pair of complementary filters is used, one having a sharp cut-off on the longer wave-length side between the source and the scattering substance to isolate a definite exciting line from the exciting source of light, and the other having a sharp cut-off to the shorter wave-length side in the path of the scattered light in order selectively to weaken or absorb the exciting wave-length. Using this device, it is now possible to record the faintest lines and bands in the spectra of crystal powders and even of amorphous solids by giving suitably long exposures.

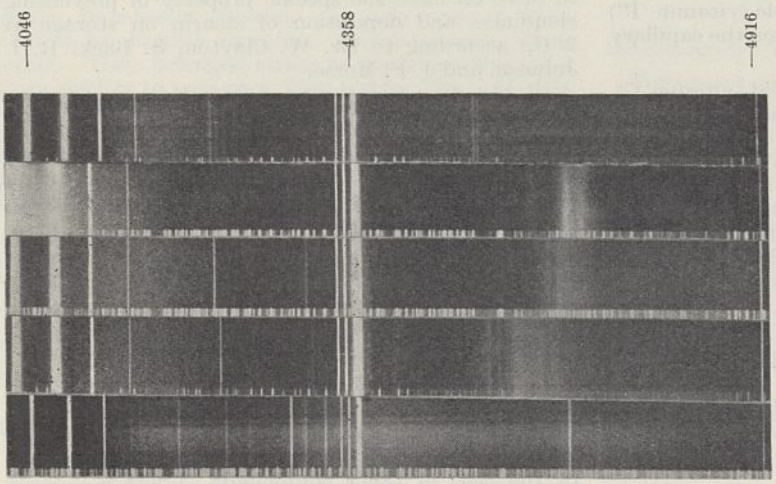


FIG. 1. Raman spectra of (*a*) crystalline phosphorous acid, (*b*) ammonium chloride, (*c*) hydroxylamine hydrochloride, (*d*) hydrazine hydrochloride, and (*e*) naphthalene.

Illustrations of the power of the new technique are furnished by Fig. 1 in which are reproduced the Raman spectra of crystalline phosphorous acid, ammonium chloride, hydroxylamine hydrochloride, hydrazine hydrochloride, and naphthalene, λ 4046 being the exciting wave-length in all cases. While Bär was able to record only five Raman frequencies in the spectrum of naphthalene crystals, not less than twelve frequencies can be identified in the above photograph. The N—H bands in the solids of the ammonium group have been recorded clearly and distinctly for the first time.

One of the interesting results furnished by the new technique relates to the constitution of phosphorous acid. The Raman spectrum of this acid shows a pair of sharp and intense lines with the frequency shifts 2,486 and 2,509 cm.$^{-1}$. These frequencies presumably arise from a P—H vibration, and show that the constitution of the acid is $O = P\begin{smallmatrix}H\\ \diagup\\ \diagdown\\ OH\\ OH\end{smallmatrix}$. This conclusion is supported by the Raman spectrum of sodium phosphite, Na_2HPO_3, which shows a strong Raman frequency at 2,335 cm.$^{-1}$.

R. ANANTHAKRISHNAN.

Department of Physics,
Indian Institute of Science,
Bangalore.
Sept. 27.

[1] A. C. Menzies, NATURE, **124**, 511 (1929).
[2] R. Bär, NATURE, **124**, 692 (1929).
[3] R. Ananthakrishnan, *Current Science*, **5**, 131 (1936).

Water under the Western Ice Cap in North-East Land

AT the station maintained from September 1935 to June 1936 near the centre of the Western Ice Cap in North-East Land (80° N., 20° 30′ E., approximately) by the Oxford University Arctic Expedition 1935–36, it has been found that, contrary to expectation[1], the ice-cap is not frozen to any great depth. While a shaft was being excavated in the *firn* beneath the station, a *concealed* crevasse was discovered—there was absolutely no trace of it at the surface, even during the period of summer thaw—and investigated to a distance of some hundreds of feet in the horizontal direction. At a depth of some 70 ft. below the surface was a lake of *water* varying in depth from 3 ft. to 6 ft. The bed of the lake was of ice.

There is reason to believe that this water remains in the liquid state throughout the year, and preliminary calculations give an estimate of the order of fifty years for the age of the crevasse at water-level.

It is hoped to publish fuller results, with detailed figures, later.

ROBERT MOSS.

Electrical Laboratory,
Oxford.

[1] J. E. Fjeldstad, *Geografiska Annaler*, **15**, 314 (1933).

Transition Curve for the Destruction of Supraconductivity by an Electric Current

In former experiments with a tin ring[1] we found that, when supraconductivity is destroyed by an electric current, the field-strength H_{kj} corresponding to the critical current is equal to the critical magnetic field-strength H_k. In order to measure H_{kj} we have now employed the exceedingly high thermal conductivity of He II. Through a tin wire of radius 0·0056 cm. immersed in He II, we were able to send an enormous current ($1{\cdot}5 \times 10^5$ amp./sq. cm.) without noticeably heating the wire or the helium, which enabled us to determine the entire transition curve.

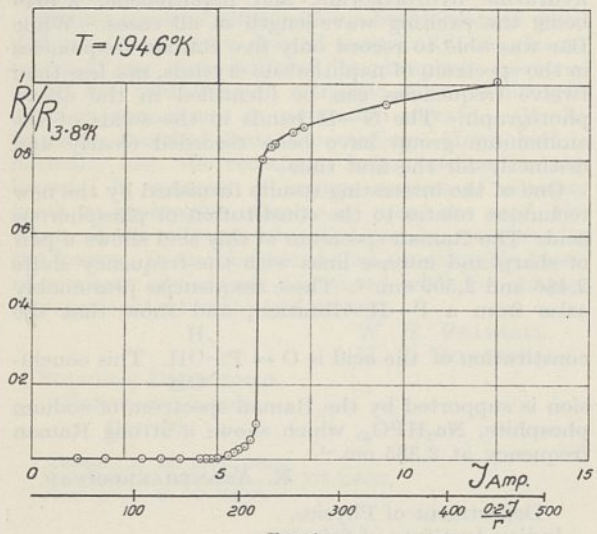


FIG. 1.

The relation between R and I—the second scale is for $H_{kj} = 0{\cdot}2\ I/r$—is depicted in Fig. 1. The resistance unit is taken as $R_{3{\cdot}8°\,K}$, that is, the resistance at 3·8° K.

Results: (1) We found that the sharp jump in the resistance corresponds to $H_{kj} = 219$ gauss, which within the limits of experimental error—a few per cent—coincides with the field-strength formerly observed[2], which was 218 gauss.

(2) The resistance rises steeply only up to $0{\cdot}8\ R_{3{\cdot}8°\,K}$. Afterwards it rises gradually to the normal value for the non-supraconducting metal.

L. W. SHUBNIKOV.
N. E. ALEXEJEVSKI.

Ukrainian Physico-Technical Institute,
Kharkov.
Oct. 6.

[1] L. Shubnikov, NATURE, **138**, 545 (Sept. 26, 1936). L. W. Shubnikov and W. J. Chotkewitsch, *Sow. Phys.*, in the press.

[2] Shubnikov, Chotkewitsch, Schepelew and Rjabinin, "Arbeiten auf dem Gebiete tiefer Temperaturen", *Sow. Phys.*, Sondernummer, June 1936, p. 48.

Points from Foregoing Letters

CURVES showing the effect of 'Citrin'—the crystalline flavone fraction of lemon juice—in prolonging the life of guinea pigs fed on a scurvy diet are submitted by A. Bentsáth, St. Rusznyák and Prof. A. Szent-Györgyi. The active principle (vitamin 'P') appears to have a marked influence upon the capillary system.

A method of estimating ascorbic acid (vitamin C), depending upon the addition of excess of methylene blue and titrating the excess with titanium trichloride, is described by Dr. Imre Gál. On the same subject, H. Cheftel and M.-L. Pigeaud state that by cooling the ascorbic acid solution to 0° C. it is possible to slow down its rate of oxidation and to obtain more consistent results by the method of Harris and Ray (titration with 2 : 6 dichlorphenol indophenol in acid solution).

By means of diet experiments on mice, Drs. A. and M. Lasnitzki have investigated the question whether 'mineral' and 'biological' potassium are equivalent, in view of the possibility that the isotopic constitution may be different. Body-weight and duration of life are affected, but the results are complex.

From the change in the diffusion constant and the rate of sedimentation in the supercentrifuge, it has been deduced that horse hæmoglobin in concentrated solutions of urea, acetamide and formamide, is partly dissociated into particles of half the original weight. Dr. J. Steinhardt puts forward further support for this view and finds that there is no denaturation in the process. He has investigated the properties of methæmoglobin and hæmochromogen prepared from the dissociated hæmoglobin, and he discusses their bearing on current theories of the equilibrium between hæmoglobin and oxygen.

Small quantities of air-blown cacao-butter added to olive oil have the specific property of preventing cloudiness and deposition of stearin on storage at 2° C., according to Dr. W. Clayton, S. Back, R. I. Johnson and J. F. Morse.

A difference in the diamagnetic susceptibility of living and dead bacteria is reported by Prof. E. Bauer and A. Raskin. This, they claim, supports Bauer's theory that the lack of equilibrium in living systems is due to an 'excited' state of the protein molecules of the protoplasm.

Two cases of loss of nitrate (due probably to formation of free nitrogen), one in a culture of the unicellular freshwater alga, *Chlorella*, and another in the presence of daffodil leaves, are reported by Dr. W. H. Pearsall and M. C. Billimoria.

Dr. A. Clow and J. M. C. Thompson find that the diamagnetic susceptibility of carbon dioxide agrees with that calculated from the 'resonance' energy according to the formula of Pauling and Sherman. In the case of other compounds, differences occur between the calculated and the experimental values, and the authors suggest certain possible interpretations.

Using an improved device for obtaining Raman spectrograms with crystal powders, R. Ananthakrishnan has obtained evidence indicating that the constitution of phosphorous acid should be represented by $O = P\begin{smallmatrix}/H\\-OH\\\backslash OH\end{smallmatrix}$.

Research Items

Garments from Yunnan

THE late Prof. Augustine Henry, well known as an authority on forestry, was stationed in southern Yunnan as an officer of the Chinese Customs in the last decade of last century. He then made a study of the little-known peoples of the country, including the Lolo, more correctly known as the Nosu. A small collection of clothing which he brought back to England, described as 'Lolo', but now shown to be Miao, was presented to the Manchester Museum by Mrs. Henry. It has since been studied and described by the Misses Laura E. Start and Mabel C. Wright (*Notes from the Manchester Museum*, No. 37 : Repr. *Mem. Manchester Lit. and Phil. Soc.*, 80 ; 1935–36). The garments consist of four coats—a short-waisted pullover with long sleeves and the chief embroidery at the waist, two linen coats, sleeveless and short-sleeved, with shoulder and collar decoration, and a Chinese derivative, little worn by Miao women—and lastly a short skirt. All differ in technique and style from Chinese work. The description 'Lolo' is shown to be incorrect, as Lolo women wear jackets and long petticoats (which are rarely heavily embroidered) silver ornaments and a long felt cloak. This last is a prominent feature in the clothing of both sexes. The Miaos, who are tenants or serfs of the Lolo, call themselves *mp'eo*, a sound which means "embroidery". The amount of embroidery on the clothing of a Heh Miao young woman is astonishing ; and it takes them years to embroider the jackets or skirts, in which they hope to be married. The embroidery on the garments now in the Manchester Museum, the only ones of their kind in an English museum, clearly indicates their origin. They belonged either to the concubine of a Nosu chief or to serfs on a Nosu estate. The materials used are local cloths made from flax or wool, with trimmings of silk, cotton and wool. Cotton cloth is obtained from the Shan, the only people of the region who now weave cotton. The ornament, hand sewn, is mainly geometric, and well placed. Possibly Chinese influence can be traced ; but Shan influence is more marked, for example, in the use of coloured cloths applied in strips and small pieces, in borders, and joined in large pieces to give variety of colour. Two unusual methods employed in making patterns are folding to produce a strip effect, and a stitching giving a brocade texture.

Mound Builders in Louisiana, U.S.A.

AN examination by Mr. Winslow M. Walker in 1931–32 of the remains of a group of mounds in Louisiana has preserved evidence relating to early indigenous culture, which was in danger of being lost entirely. The mounds, upon which now stands the township of Jonesville (formerly Troyville) in Catahoula Parish, near the junction of the Tensas, Black, or Ouachita, and Little Rivers, eighteen miles west of the Mississippi, are thought to be identical with the capital city of the Province of Anilco visited by de Soto in 1542. They were seen by Duncan and Hunter in 1804. The remarkable feature of the group was then a conical mound raised on a pyramidal platform with two terraces, and there is evidence to show that it had a total height of eighty feet. This would make it second in height only to the Cahokia mound in Illinois. It was partially destroyed in the American Civil War, and finally levelled in 1931, when great sheets of cane, pottery, bones and variously coloured clays were brought to light. The neighbouring mounds have been used for house sites, but enough remained of the great mound beneath the levelled surface to yield to Mr. Walker's excavation something of the cultural history and evidence of the method of construction (*Bull.* 113, *Bureau of American Ethnology*). Excavation of part of a burial ground near the river brought to light a number of burials ; but there was no certain indication of a connexion between the human remains and the former inhabitants of the mounds. The artefacts found in the remains of the mound were not numerous, the most important being the pottery, which though extremely fragmentary, afforded material for a classification into a number of types. The most remarkable feature was the constructional use of cane in layers of some thickness. There is evidence of at least two periods of occupation or construction, of which the earlier resembles that of the Hopewell Mound builders of Ohio, and the second inaugurated important structural changes. The last inhabitants of the site may have been the Taensa or the Avoyel, both related to the Natchez, who were broken up by the French in the eighteenth century.

Inheritance of *l*-Xyloketosuria

THERE are known to be at least two types of the rare chronic pentosuria, differing in the nature of the pentose sugar found, one being optically inactive *dl*-arabinose and the other *l*-xyloketose. The latter—a quite abnormal sugar—is now well authenticated, and a simple new test devised by Lasker and Enklewitz facilitates its identification. The same authors have adduced evidence that *d*-glucuronic acid is the precursor of the pentose, though on theoretical grounds the conversion is difficult to follow from the formulæ of the two substances. At any rate the administration of glucuronic acid causes a greatly increased elimination of this pentose in the urine. What is more interesting is the observation (*Human Biology*, 8, No. 2 ; 1936), based on the study of twenty pentosuric families, as to the inheritance of *l*-xyloketosuria. The urine pentose of thirty-seven individual members has been identified as this sugar. The disease is very rare in the general population, but is frequently found in the families of known cases. Most cases are among Jews. The disease was present in children of ten families in which neither parent shows evidence of it. One case was a child of first cousins. These facts are regarded as indicating strongly that *l*-xyloketosuria is inherited as a recessive character and controlled by a single recessive gene.

Shore Fauna of the Arctic

THE East Greenland Polar Current bathes the shores of east Greenland in low-temperature water and gives rise to much more severe conditions there than obtain on the west coast. Holger Madsen has surveyed the area 70° 29′ N. to 74° 05′ N., and finds that life in the littoral and supralittoral zones is limited to comparatively few species ("Investigations on the Shore Fauna of East Greenland with a Survey of the Shores of other Arctic Regions". *Medd. Grønland*, **100**, No. 8; 1936). *Fucus vesiculosus*, *Balanus balanoides*, and *Littorina saxatilis* var. *grœnlandica*, all of which occur in the same longitude on the west coast, are absent here, and the common forms are oligochætes, dipteran larvæ, and certain mites and nematodes. The first two may be present in numbers as great as 18,000 and 27,000 per square metre respectively. In the first part of this paper, a detailed account is given of the faunas of the different types of facies—rocky, gravel, clay, etc., and in the second part the area is compared with the west coast of Greenland and with the other known arctic and subarctic shores. The survey of the scattered literature on this subject is of particular value.

Fishes from West Borneo

Treubia (Deel 15, Aflevering 3; 1936) contains a paper by Dr. J. D. F. Hardenberg (Laboratorium voor het Onderzoek der Zee, Batavia) "On a Collection of Fishes from the Estuary and Lower and Middle Course of the River Kapuas", in which he describes a large number of interesting species, adding many records to the fauna of Borneo. These were to a large extent collected from the fish-market at Pontianak, caught in an affluent of the River Kapuas and on the adjoining coast. Others came from streams connected by numerous water courses with the Kapuas, and from the Peniti River, the last coming from farther up the river and from some of the great lakes near. The author gives notes wherever possible on the various species used as food, their local names and feeding habits besides the morphological descriptions.

Anatomy of a Nyphomyiid Fly

IN 1932, Mr. M. Tokunaga announced the discovery of a new dipterous insect in Japan, which he described as *Nymphomyia alba* gen. et sp. nov. It exhibited a combination of peculiar features which led him to establish the family Nymphomyiidæ for its inclusion. He now discusses the nervous, tracheal and digestive systems of this insect (*Philippine J. Sci.*, **59**, No. 2, 189; 1936). As regards the nervous system, he describes the ventral nerve cord as consisting of three thoracic and eight abdominal ganglia. The presence of eight separate ganglia in the abdomen is frequent among dipterous larvæ but very rare in the adults of the higher Pterygota. In the tracheal system there are only two pairs of functional spiracles, namely, meso- and metathoracic, while vestigial closed spiracles are present in the abdomen. The tracheal system itself is very simple, consisting of two main longitudinal trunks with very few transverse anastomoses. The alimentary canal is of relatively simple structure: there is no trace of crop or sucking stomach, and histologically the gut shows no evidence of serving a digestive function. The Malpighian tubes are only two in number and open into a common ventral excretory chamber. The structure of the cells of the tubes are peculiar in that small intracellular tubuli open into a common central canal.

Studies of Frost Hardening

IN a very suggestive investigation upon this subject (*Canadian J. Res.*, **14**, Sec. C, Aug. 1936) by J. Levitt and G. W. Scarth, comparisons were made by the plasmolytic method of the permeability of the cells of corresponding tissues of various herbaceous and woody plants in the unhardened and hardened state. Frost hardening of herbaceous seedlings was carried out by keeping them for some days in a cold chamber, in the case of the woody plants; in addition to twigs thus artificially hardened, comparisons were made with tissues brought in from the open country where they were undergoing the normal seasonal hardening during winter. The result has been to show an unexpectedly definite effect, a marked increase in permeability with hardening. It is concluded that cell permeability in the hardened state shows a better correlation with ability to resist frost than any other character so far examined. The permeability change is most marked towards a salt like potassium nitrate; the change is less marked towards polar non-electrolytes with small molecules such as urea; there is no change towards an apolar substance such as urethane. The authors suggest that these phenomena point to an increase in size of the aqueous pore surface in the plasma membrane as a result of the exposure of the living tissues to cold.

Hudson Strait Survey

THE sixty-ninth annual report of the Canadian Department of Marine for the fiscal year 1935–36 (Ottawa: J. O. Patenaude, price 25 cents) contains interesting information respecting the exploratory survey work now in hand in connexion with the development of navigation in Hudson Bay to and from the recently established port of Churchill. The principal feature of the season's operations was the charting of a deep-water channel inside the Digges Islands and close to the continental coast, and extending for a distance of twenty-two miles from Wolstenholme to the westernmost islet. It is more than a hundred fathoms in depth and so straight that two courses only are required. The new channel, called Digges Island Sound, is reported as being ice-free in the late fall for some ten days after the usual ship's route, north of the Digges Island, and it shortens considerably the distance from the sea to places on the eastern side of Hudson Bay and to Moosonee in James Bay. The newly charted channel possesses a bleak grandeur. At the eastern entrance of the Sound on the mainland side stands Cape Wolstenholme, with perpendicular walls rising a thousand feet from the water's edge. From this great headland, the Sound is walled for several miles by enormous cliffs. Thousands of guillemots and murres come yearly to these cliffs to breed and, in the summer months, the place is alive with their clamour.

Silting of Reservoirs

THE problem of the silting of reservoirs by stream-carried material and the means of reducing the erosion are being widely studied in the United States by the Soil Conservation Service of the Department of Agriculture. The first report dealing with representative reservoirs in the southern areas has been published (Silting of Reservoirs. By H. M. Eakin. Washington, D.C.). The rapid silting would appear to be due to the broad prevalence of soil erosion induced by human occupation. The highest rates

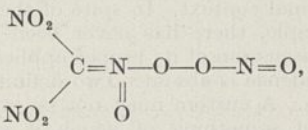
go with agriculture: the lowest with forest cover. In other parts, particularly dry areas, silting is accelerated by over-grazing and the consequent reduction of the plant cover. The prevention therefore of this growing menace seems to lie in the control of soil erosion by improved methods of agriculture, reclamation of steep slopes, extension of forest growth, and restriction of over-grazing. Fire prevention and rapid planting of burnt areas are other ways of reducing silting. The report includes full instruction for reservoir sedimentation surveys.

Scintillations of Zinc Sulphide

THE scintillations produced on a zinc sulphide screen by α-particles have served, as is well known, in counting the number of such particles emitted by a radioactive preparation. Various specimens of zinc sulphide have very different activities in this respect, and the suitability is connected with the size of the crystals, the presence of traces of impurities, etc. In a study of the phenomenon, G. Destriau (*J. de Chimie Phys.*, **33**, 587; 1936) has indicated some further interesting features. The sensitivity of a specimen of zinc sulphide to α-rays is not connected with the phosphorescent properties in relation to light, since a sulphide which is phosphorescent can give no scintillations, and vice versa. The fluorescence under X-rays, on the other hand, is closely related to the brightness of the scintillations. It was possible to produce luminescence in zinc sulphide by the action of an electric field.

Constitution of Tetranitromethane

THE constitution of the compound $C(NO_2)_4$ has recently engaged the attention of the Czechoslovak chemists, Prof. Cyrill Krauz and Dr. J. M. Štěpánek (*Chem. Obzor.*, **11**, 153 and 177; 1936). These authors conclude that none of the structural formulæ previously assigned to tetranitromethane (TNM) fully explains its chemical reactions. Not one, for example, explains its oxidizing properties. The substance can scarcely be regarded as a true tetra-nitro-compound since one nitro-group is more reactive than the others, and a new structure is suggested, namely:



which accounts for the formation of nitroform as an intermediate and as a decomposition product. Tetranitromethane acts most strongly as an oxidizing agent in alcoholic solution. A peroxide hydrogen atom is given up in the presence of such reducing agents as sulphides, sulphites, arsenites, hydrazine and hydroquinone, with the liberation of nitroform. Iodine is set free from iodides not only in the presence of acids but also in neutral and even weakly alkaline solutions. The above formula also indicates how guanidine, methylamine, ammonia and nitrogen can be derived from tetranitromethane, and its formation by the interaction of silver nitrite and iodonitroform is at once apparent. The compound is not decomposed by anhydrous sulphuric acid or by glacial acetic acid, and the authors obtained no evolution of gas in Lunge's nitrometer on treating tetranitromethane with concentrated sulphuric acid, although with the dilute acid the decomposition became very violent.

Electrical Prospecting and its Uses

IN a paper presented at the Second Congress of the International Commission on Large Dams at Washington on September 10, C. and M. Schlumberger show how to utilize the fact that underground formations differ largely in their electrical resistivity. The electrical current conducted by rocks varies largely with the amount of assimilated water they contain. Rocks like granite, gneiss, marble and all rocks in which the spaces of pores form only a very small fraction of the total volume have a resistivity varying between 200 and 3,000 ohms per cubic metre; for clays, marls, soft limestones, etc., it varies from 10 to 30 ohms. The large differences between the resistivities show that they can be usefully employed to foretell the nature of the foundations on given sites. Since the measurements made are at small depth, the necessary equipment is very light and easily handled. It consists of a potentiometer, a few dry-cell batteries, two reels of cable and copper pegs to make the earth contacts. If it is required to find the exact depth of the bedrock by an electrical sounding, an average of about four measurements per day can be made, but even so the cost is very small when compared to that of mechanical drilling. When a large surface has to be surveyed to determine a suitable site the technique is different, and an efficient operator can make about forty measurements per day, a different method being employed. The results obtained in four practical applications are given: one in France, two in the United States and one in Canada. In predicting the depth of the bedrock in one case, the maximum error made was nine per cent and the average error 6·4 per cent. A translation of the paper, which is in French, is given in *World Power* of September.

Discrete Space-Time

IN the course of five lectures delivered in the McLennan Laboratory of the University of Toronto in January and February 1936, and published in pamphlet form (*University of Toronto Studies, Physics Series*; University of Toronto Press, 1936), Dr. L. Silberstein examined some of the consequences of the hypothesis that both space and time are discrete instead of being continuous. This would imply, for example, that in any finite volume the number of positions that a particle could occupy would be, although very large, not actually infinite, and that in describing its motion all that could be specified would be its position at very short intervals of time, as in a cinematograph film. Such an assumption has much in common with the postulates of quantum theory. Dr. Silberstein shows that discrete space-time is compatible with the restricted relativity theory, at least to a high degree of approximation. But, as no place is left for infinitesimals and hence for covariant tensors, the general or gravitational theory is ruled out. To the ordinary physicist this seems regrettable; but Dr. Silberstein, for reasons not explained, declares that "the generalized relativity theory is far from being firmly established, and its heuristic power, its successful predictions (of which one, that relating to the perihelion motion of Mercury, seems very doubtful) seem to be nearing exhaustion, while certain rigorous conclusions recently drawn from Einstein's general-relativistic theory of gravitation by the writer turn out to disagree with some most fundamental facts of experience".

Methods in Social Anthropology*

IN opening his lecture in memory of Thomas Henry Huxley, Prof. Westermarck said that it was calculated in a peculiar way to call to his mind the first steps he ventured to take in social anthropology nearly fifty years ago, when, being concerned with the origin of marriage, and thinking with other scholars of the time that primitive man lived in a state of promiscuity, he became acquainted with the doctrine of organic evolution and drew the conclusion that the social habits of the anthropoids might throw some light on those of primitive man. It is now to be regarded as amply proved that among many of the apes the social unit is the family, and it may be concluded that the factors which necessitated marital and paternal relations among the apes also presumably operated among our earliest human or half-human ancestors. He went on to point out, however, that apart from its role in the production of instincts, the principle of natural selection does not render us much help in our search for social origins.

In his study of social origins, the sociologist is much better situated than the biologist in his study of organic evolution. Natural selection presupposes organic variation, but scarcely anything is known about the origin of these variations. The causes of social phenomena, on the other hand, are to an almost unlimited degree accessible to the sociologist; and it is his business to find them. The methods of sociology, therefore, are ultimately the methods of finding the causes of social phenomena.

One method of social anthropology is the comparative one. This method starts from the fact that there are great similarities between the products of culture. The task of comparative sociology is not so much to classify these facts as to answer the question why there is this similarity. Tylor, Huxley, Frazer, have all recognized the fact that these similarities may be due to a similarity in the operations of the human mind in like conditions, or they may be due to diffusion or borrowing; and the criticisms of Rivers, Elliot Smith and others to the effect either that the possibility of diffusion is not recognized, or if it is that this involves a contradiction, are not well grounded. It is true that the question whether a certain custom or institution has sprung up independently among the people or tribe practising it, or whether it has been introduced from some other people or tribe, is seldom discussed in comparative treatises. But this by no means implies the assumption of independent origin; on the contrary, when the custom or institution occurs among related or neighbouring peoples, there is, at least in many cases, a tendency almost to take it for granted that it has been derived from a common source. Taking the study of proverbial sayings as an example, peoples have at all times taken adages from each other. But it must always be borne in mind that the resemblance between proverbs may have another cause than diffusion, namely, the people's tendency to express themselves in apophthegmatic sayings, which, owing to their terseness, are apt to become more or less similar in similar situations. The real test of a common origin is, therefore, not the mere similarity of ideas and sentiments revealed in the proverbs, but the similarity of formal expression, with due allowance for modifications that are liable to occur when a saying is adopted from another language and transplanted into a new soil.

Another branch of cultural phenomena in which diffusion has played a prominent part is decorative art. The diffusion may not in every case refer directly to particulars in the design; it may also be an independent effect of the idea underlying it. The patterns used in Morocco were originally to a large extent charms against the evil eye. They are based on two principles, the hand, or its five fingers, and the image of an eye or pair of eyes. Both types of charm are spread all over the Mediterranean, and many of them also farther east, and are proved to have existed since very early times. This does not preclude the possibility of more or less similar representations of protective objects having in certain instances originated independently, which is illustrated by the occurrence of designs or charms on the leather bags of the mountaineers of Morocco in the form of a pair of eyes resembling the capital of an Ionic column. That the capital of an Ionic column may have its origin in a charm against evil protecting the temples of the Greeks would be no wonder; but it is extremely improbable that the Moorish charms have been copied from the Ionic capital. Their resemblance is easily explained by a common belief that the representation of the eyes serves as a protection against the evil eye. Widely distributed, the eye ornament may have a different meaning in different cases, illustrating a weakness in the method of diffusionists, who have a tendency to rely on external resemblances only.

Comparative study further may enable us to discover that certain customs are vestigial forms, so-called survivals—a custom which cannot be explained by present circumstances, but persists in isolation from its original context. In spite of the importance of this principle, there has never been any general theoretical discussion of its proper application, where historical evidence is absent. Two definite rules may be laid down. A custom must not be interpreted as a survival of something of which it cannot be a survival, and it must not be regarded as the survival of something, which is not known to have existed, or the earlier existence of which may not be assumed for some other reason, as for example in the so-called survivals of an ancient state of group marriage.

Nowadays the reaction against the evolutionary school of anthropologists has become so strong that any attempt to conjecture the origin of a social institution or of an element of culture has been pronounced to be out of place in social anthropology. It is, however, in this field that social anthropology has performed some of its most important tasks. Its results are to a large extent as well established as any reached in any sphere of research. The common complaint of the 'new anthropology' that the comparative method detaches the cultural phenomenon from the organic whole, of which it forms part, is largely due to the incompleteness of the sources at the sociologist's disposal, and can be remedied by

* Substance of the Huxley Memorial Lecture for 1936, delivered by Prof. Edward Westermarck before the Royal Anthropological Institute on October 27.

careful monographs on particular cultures. The 'new anthropology' aims at discovering general laws, but it is doubtful whether such general laws, if discovered, would be of much service in investigating social phenomena.

On the other hand, the view expressed by Prof. Radcliffe-Brown that "no insight, however genial, can fully compensate for the absence of direct personal contact with the kind of material that the anthropologist has to study and explain", is to be fully endorsed. It is borne out by Prof. Westermarck's personal experience of nine years close contact with the Moors, spread over more than three decades, and spent in investigating their customs and ideas.

Morphogenesis and the Field Concept

THE discussion on morphogenesis which was held in Section D (Zoology) during the Blackpool meeting of the British Association was concerned mainly with the use of the field concept in experimental embryology. The central problem of the causal analysis of development is to account for the production of organs, that is to say, of masses of tissue which are integrated into units. Such integration can only be dealt with in terms of something which extends throughout the whole volume of the mass, and such extended entities are now usually referred to as 'fields'.

The first problem which arises is to give a satisfactory description of the integral behaviour. The sequence of shapes which are assumed by an organ during development has been described in great detail for most animal organs, but we require now some way of summing up, for each organ, the whole assemblage of shapes in a way which expresses the unitary character underlying the series. Probably a new branch of mathematics will be necessary to deal with such unfolding of even more complicated forms, though Dr. J. Needham mentioned the application of topological analysis and Gaussian curve analysis as hopeful possibilities. Mr. C. H. Waddington gave an example of what can already be attempted in some of the simpler cases ; the shape of the notochord and somites of the early chick embryo can be expressed as the product of two damped wave functions, with the time variable in the expression for the damping of the longitudinal wave function, so that as time proceeds more waves (that is, somites) are formed. It is possible, by causing the embryonic body to develop in a bent form, to distort the co-ordinate network in which the functions are measured, and experiments of this kind may make it possible to choose, from mathematical possibilities, the particular formulation which most immediately expresses the actual forces at work.

The integrated or organized behaviour of developing organs is shown by the regulation of parts of the organ to reconstitute the whole ; such experiments make it clear that the behaviour of a part of a developing organ is a function of its position in the whole. Dr. P. D. F. Murray described some beautiful examples of this type of behaviour, taken from his own earlier work on chorio-allantoic grafts of fragments of the limb-bud of chick embryos, and from Miss H. B. Fell's recent work on tissue culture of the same material. Thus if the isolated fragment contains slightly more tissue than would normally take part in the formation of the femur, it nevertheless forms no more than a complete femur, which therefore incorporates the extra tissue. Dr. Murray also discussed the mosaic development of later stages in which regulation is no longer possible. Prof. E. A. Spaul's interesting and important communication on the hormonal control of metamorphosis in Amphibia also dealt with aspects of morphogenesis which do not come into the scope of this short note.

Regulation can only be analysed in ordinary causal terms if we suppose that the series of whole unit shapes, to which regulation occurs, is an equilibrium-series, that is, an equilibrium which is not constant but follows a definite course in time. According to this view, all the forces which at any time produce the developmental form-changes of an organ are in equilibrium with one another, and if the equilibrium is disturbed, for example, by removing part of the tissue, the same forces restore the equilibrium and thus cause the regulation of the organ. Regulation is therefore due to the interaction of forces proceeding from the different parts of the developing organ-rudiment. In so far as it is dependent on forces proceeding from different parts, it is dependent on local differences within the organ rudiment, and is in this respect similar to mosaic development, which is often and wrongly taken to be the exactly opposite type of behaviour to regulation. According to the present point of view, the differences between them are much less important ; both types of behaviour depend upon local differences within the developing mass, but in cases where regulation occurs these differences are still labile and are capable of being altered by their mutual interaction, while in the mosaic stage the differences have become fixed and stable.

Dr. Needham concerned himself mainly with the nature of the forces which are concerned in setting up such equilibria. He directed particular attention to the possibility of finding a basis for the structural differentiation of masses of tissue in the arrangement of anisomorphic micelles or molecular aggregates. We know both that such molecules exist in protoplasm and that they can be arranged into orientated masses of the nature of liquid crystals. Such facts make it possible for the biochemist to form a picture of what it is the embryologist may be referring to when he invokes a '*cytosquellette*' or an '*Intimstruktur*'. The time has not yet come, he said, for an attempt at a detailed application of such ideas. We want to know, in particular, something about the maximum size of the volumes which can be affected by such molecular structures. Can we expect the orientated arrangements to be large enough to be invoked as an immediate explanation of such phenomena as the closure of the neural plate or the gastrulation movements in an amphibian egg, or must we only expect to find them active as determining the positions of other agencies which are the immediate causes of the more large-scale changes of form ?

C. H. WADDINGTON.

Dietary Standards

IN December 1935, a Commission of Experts (Technical Commission) appointed by the Health Committee of the League of Nations issued its London Report on the "Physiological Bases of Nutrition" (see NATURE, Feb. 1, p. 176). The publication of this report was followed by its communication for study to representative learned societies, social studies institutions and health administrations in various countries. Observations received from such sources indicated general approval of the purpose and content of the report. Several suggestions were made, however, regarding details which might deserve further consideration. These were examined at a further meeting of the Technical Commission at Geneva in June last, with the result that a revised edition of its report has now been published*.

The most noticeable changes in the new edition are those which amplify the previous sections dealing with the feeding of children. The general principles of infant feeding are dealt with in greater detail. Such topics are now included as the use of heated milk to prevent milk-borne infections, the methods of preventing nutritional anæmia and the special requirements of premature infants. Dietary schemes are now included for children in the age groups 5–7 years and 12–14 years as well as for those in the younger groups. Incidentally, the energy allowances for children in the age groups 1–2 years and 2–3 years have now been slightly raised. A further alteration of note concerns the energy allowances for adults. It may perhaps be remembered that in the original report an allowance of 2,400 calories a day was suggested for men and women alike, with supplements for muscular activity varying according to the severity of the work performed. In the revised edition, the basal allowance is the same, but the supplements are increased, so that for light work the new scale allows up to 75 calories per hour of work in place of 50, for moderate work 75–100 calories in place of 50–100, for hard work 150–300 instead of 100–200 and for very hard work 300 calories and upwards instead of 200 and upwards.

Certain general principles regarding the choosing of suitable dietaries are set forth in greater detail in the new edition. The modern conception of 'protective' foods is elaborated; the term is defined as including foods which are especially rich in those nutrient principles (good protein, vitamins and minerals) in which the chief foods of any geographical area are deficient. Good protein might thus be a valuable protective food in an Asiatic diet but not in a Western diet where a scarcity of it is comparatively rare. Attention is directed to the value of lightly as opposed to heavily milled cereals as a source of iron and vitamin B_1, and to butter in preference to other common fats because of its richness in vitamin A. The consumption of excessive amounts of sugar is condemned for the reason that it tends to lessen the proportion of protective foods in the diet as a whole. Lastly, the Commission has added to its list of problems requiring serious study the investigation of the optimum amount of milk required by human beings at different ages.

* "Report on the Physiological Bases of Nutrition." Revised and amplified at the meeting held at Geneva, June 4–8, 1936. *Quarterly Bulletin of the Health Organisation, League of Nations*, **5**, 391 (London: George Allen and Unwin, Ltd., 1936).

Educational Topics and Events

CAMBRIDGE.—The Vice-Chancellor gives notice that the professors of physiology (Sir Joseph Barcroft), social anthropology (Prof. T. C. Hodson) and zoology (Prof. J. Stanley Gardiner) are due to retire on September 30, 1937.

Prof. Th. Von Kármán, of the California Institute of Technology, has been appointed Rouse Ball lecturer for the year 1936–37.

The following have been approved for the degree of Sc.D.: W. L. Edge, of Trinity College, and Dr. R. G. W. Norrish, of Emmanuel College.

At Clare College, E. N. Willmer, of St. John's College, University lecturer in physiology, has been elected into an official fellowship.

At Newnham College, the Henry Sidgwick Memorial Lecture will be delivered on November 28 at 5 p.m. by Lord Rutherford. The subject of the lecture is "Modern Alchemy".

The Adams Prize is open to the competition of all persons who have at any time been admitted to a degree in the University. Women are also eligible. The subject proposed for the period 1937–38 is the distributional properties of functions of statistical variables.

LONDON.—The following degrees have been conferred: D.Sc. (Economics) on R. P. Tripathi, an internal student, of the London School of Economics; D.Sc. on E. E. Jelley, an external student, and D.Sc. (Engineering) on R. W. Bailey, an external student.

OXFORD.—W. D. Hambly, of Jesus College, has been granted the degree of D.Sc. for his work in social anthropology.

Dr. J. A. Douglas has been appointed deputy for the professor of geology during the vacancy.

THE bicentenary of the University of Göttingen will be celebrated in the last week of June 1937.

THE International Congress on Technical Education which was to have been held in Rome on May 28–30 but was indefinitely postponed will take place there on December 28–30. The Congress is under the auspices of the Bureau international de l'enseignement technique, 2 Place de la Bourse, Paris, from which further information can be obtained.

THE following scholarships, which are tenable for three or four years, according to the length of the course at the university selected, will be offered by the Institution of Naval Architects for competition in 1937: *Naval Architecture:* Martell, £130 per annum; Trewent, £125 per annum; Denny, £75 per annum. *Marine Engineering:* Parsons, £150 per annum; Yarrow, £100 per annum; Denny, £75 per annum. Full particulars may be obtained from the Secretary of the Institution of Naval Architects, 2 Adam Street, Adelphi, London, W.C.2.

ADULT education offers to a community suffering from the lag of the social sciences behind the advance of the natural and technological sciences and threatened by consequent social disorganization a potent remedial instrument. It has, to use a metaphor popularized by Sir Josiah Stamp *a propos* of the "impact of

science" in his address to the British Association, a high potential value as a 'shock-absorber'. This has been recognized in the United States, and is one of six reasons assigned by Dr. Floyd W. Reeves, professor of education in the University of Chicago, for the recent rapid expansion in adult education in the United States, the other reasons, less significant and compelling, being: activities of the American Association for Adult Education, organized in 1926; increased leisure; need for retraining for new occupations resulting from technological progress; Thorndike's exposure of the fallacy that adults rapidly lose ability to learn; and the success of a widespread drive to promote parent-education so as to facilitate the introduction of reforms in school-teaching methods, notably in methods of teaching how to read. Dr. Reeves is consultant and was director of personnel to the Tennessee Valley Authority, and he has contributed to *School and Society* (Aug. 29) a paper on adult education as related to the T.V.A. In the co-operative commonwealth administered by this body, its adult educational programme holds a key position. In the systematic employment in this field of four new instruments—the public library, radio, visual education and public affairs forums—the authority is pre-eminent among educational agencies. A three-weeks observational tour revealed great keenness among the learners, numbering more than 25,000, and a high standard of efficiency among the teachers, more than half of whom give their services without pay in their spare time. Concerning adult education in the country as a whole, Dr. Reeves quotes statistics indicating that the participants in 1934 numbered more than twenty-two million.

Science News a Century Ago

A Balloon Voyage from England to Germany

THERE were several notable balloon voyages in 1836, but none of them excited greater interest than that by Charles Green in the great Nassau balloon from the Vauxhall Gardens to Weilburg, in the Duchy of Nassau, on November 7–8, 1836. The balloon had a full equipment of scientific instruments, provisions for a fortnight and an apparatus with which it was hoped to be able to keep the balloon afloat if it was necessary to come down on the surface of the sea.

With two companions, Green ascended at 1.30 p.m. on Monday, November 7, and landed at Weilburg at 7.30 a.m. on Tuesday, November 8. When he passed over Dover, a message for the Mayor was sent down in a parachute. Writing of the episode in the *Athenæum*, "W. P." said: "We look forward with some anxiety to the receipt of a more detailed account of this interesting adventure, the perfect accomplishment of which must have realized the most sanguine expectations of the gentlemen who undertook it. It is no matter of wonder that it should have excited the public attention with such a lively interest, for to say the least of it, it has furnished a fact which is quite new in the history of man—that of his having travelled a distance of from four to five hundred miles in the short space of eighteen hours, or in other words, having travelled, in that period, a distance which is not usually accomplished in six times as many hours".

The Human Brain

IN a review in the *Athenæum* of November 12, 1836, of "The Human Brain, its Configuration, etc., illustrated by references to the Nervous System of the Lower Animals", by Samuel Solly, the writer said: "This is a scientific book by a scientific man, and written rather for the profession than the public. We hope, however, that every day will bring physiology more within the range of general education, and that future generations will know something more of themselves, physically as well as morally, than their ancestors did, in the ignorant past. . . . Hitherto as he himself firstly observes, the information conveyed of the anatomy of the brain, by systematic works, has amounted to little more than a vain catalogue of names, applied to parts, without reference to their structure, their functions, or even their analogies in the nervous system of the lower animals. . . . That Mr. Solly should have abandoned this method, and broken through a long night of ancient usage, to proceed in a truly scientific plan . . . is good *primâ facie* evidence in favour of his mental qualifications for the task he has undertaken; and his perpetual reference to comparative anatomy shows an equal contempt for the spirit of routine, which has so long possessed the medical constituted *corps* of London. . . ."

Samuel Solly (1805–71), the author of the book, had been trained under Benjamin Travers (1783–1858), surgeon to St. Thomas's Hospital, London, and was elected a fellow of the Royal Society in 1837.

Identification of the Body of Charles I

IN a lecture on this subject delivered at the Aldersgate School of Medicine and reported in the *London Medical Gazette* of November 12, 1836, Dr. William Cummin gave the following account of the identification of the remains of Charles I, when a search conducted by Sir Henry Halford was made for them at St. George's Chapel, Windsor: "The particular vault in which the coffin was deposited had long remained unknown, though it was understood to be the one in which Henry VIII and one of his wives were laid. Accident led to its detection. A scroll with name and date served in some measure to authenticate the outer covering; but the examination of the head left not a doubt of the identity of the royal remains. Upon disengaging the face from the cere-cloth, which had been lined with an unctuous and resinous substance, apparently with a view to exclude the external air, the complexion of the skin was found to be dark and discoloured. The forehead and temples had lost little or nothing of their muscular substance; the cartilage of the nose was gone; but the left eye in the first moment of exposure was open and full, though it vanished almost immediately; and the pointed beard, so characteristic of the period of the reign of King Charles, was perfect. The shape of the face was a long oval; many of the teeth remained; and the left ear in consequence of the interposition of the unctuous matter between it and the cere-cloth was found entire. The countenance, in short, notwithstanding its disfigurement bore a strong resemblance to the coins, the busts and especially to the pictures of Charles the First by Vandyke. Finally the fourth cervical vertebra was found divided transversely—the corresponding surfaces being smooth, betokening that they had been separated by a heavy sharp instrument."

Societies and Academies

Paris

Academy of Sciences, October 12 (*C.R.*, 203, 637–696).

LOUIS BOUVIER : Correction and addition relating to the obituary notice of Jean Charcot (*C.R.*, Sept. 21, 1936).

LUCIEN CAYEUX : The impregnation with hydrocarbons of the North African phosphates and their origin.

JULIEN COSTANTIN : The production of wheat in Peru in 1932 and 1934. Discussion of the causes of the reduction in wheat production in Peru, with special reference to rust. There would appear to be an optimum altitude for the cultivation of wheat.

WERNER FENCHEL : Quadratic inequalities between the mixed volumes of convex bodies.

ERVIN FELDHEIM : The orthogonality of the Lagrange fundamental functions of interpolation.

PAUL FLAMANT : Grouping in classes of quasi-analytical functions (*D*).

PAUL MONTEL : Functions defined by series with recurrent coefficients.

KYRILLE POPOFF : The pendular movement of the projectile.

MICHEL DUFFIEUX and LÉON GRILLET : The application to microspectroscopy of the method of the astronomical prism objective.

MARIUS AUBERT : The relations between the Baeyer tension τ and the characteristic Raman frequency in the case of the cyclic hydrocarbons. The characteristic Raman frequency of the nucleus appears to be a definite linear function of the tension τ due to the deviation of the carbon valencies.

B. ROSEN and L. NEVEN : The absorption of sulphur vapour between 3600 A. and 5000 A.

HORIA HULUBEI : Weak emissions in the *L* spectrum of radium (88). Results in tabular form completing the list of stronger lines given in earlier communications (*C.R.*, 203, 399 and 542).

MLLE. MARIE THÉODORESCO : Study by the Raman effect of a tungstotartaric complex compound in water. The results favour the hypothesis that the complex compound $Na_2(TH_2,WO_3)$ exists in solution in water.

GEORGES DARZENS and ANDRÉ LEVY : The synthesis of a new isomer of retene : 1.methyl.9.isopropylphenanthrene.

HENRI LONGCHAMBON : The characteristic properties of the palygorskites. Study of the rate of dehydration as a function of the temperature.

JEAN CHEVRIER : Relations between the electric field of the atmosphere and some meteorological factors during the year 1934 at the Observatory of Ksara (Liban).

MARIO BOSSOLASCO : The nature of magnetic disturbances. Detailed discussion of the records obtained by various magnetic observatories of the magnetic storm of April 30, 1933.

RENÉ SOUÈGES : The embryogeny of the Papaveraceæ. The development of the embryo in *Chelidonium majus*.

RAOUL COMBES : The experimental production in a submerged plant of the structural characters peculiar to ærial organs.

RAYMOND CHAMINADE : The passage of potassium in soils to the non-exchangeable state.

ARTHUR VERNES : Researches on the specific substance of syphilitic fluids.

ROBERT PAULAIS : The localization of nickel in the organs of lamellibranch molluscs. The nickel is distributed in different proportions in different organs of the mollusc. *Cardium edule* contained a much higher proportion of nickel than the other molluscs examined, and this was confirmed by analysing additional specimens.

PAUL RIOU, GÉRARD DELORME and HORMISDAS : The distribution of manganese and iron in some conifers from the province of Quebec.

HUGUES GOUNELLE and YVES RAOUL : The sterilizing action of chloropicrine on the eggs of the bed bug, *Cimex lectularius*. Experiments showing that the sterilizing action of chloropicrin on the egg of *Cimex* is certain.

STIG VEIBEL and MME. HANNE LILLELUND : The fermentative hydrolysis of some β-glucosides of tertiary alcohols.

ANDRÉ BOIVIN : The possible co-existence of the complete *O* somatic antigen and of the corresponding polysaccharidic haptene (residual antigen) in certain bacteria.

Amsterdam

Royal Academy (*Proc.*, 39, No. 7, Sept. 1936).

H. J. JORDAN : The properties of smooth tonus muscles compared with those of unvulcanized, plasticized rubber.

W. A. P. SCHÜFFNER and B. WALCH-SORGDRAGER : Immunity to yellow fever among white mice.

L. S. ORNSTEIN : Scattering of neutrons in matter (1). Theory of the statistics of the scattering of neutrons by an assemblage of protons.

J. CLAY, E. M. BRUINS and J. T. WIERSMA : A temporary excess of ten per cent in cosmic radiation. Two ionization chambers and a counter all showed a sudden increase in the cosmic radiation over several days beginning on May 21.

H. R. KRUYT and G. E. VAN GILS : Electrophoresis of amino compounds.

E. D. WIERSMA : Physical resemblance in connexion with mental similarity (2).

J. J. VAN LAAR : The position of the λ-point in helium.

O. POSTHUMUS : Some Malayan ferns.

H. FREUDENTHAL : (1) Position operators in concrete Hilbert spaces (1). (2) The Friedrich extension of semi-restricted Hermitian operators.

M. EWART : The exact measurement of the specific heats of metals at high temperatures (25). The specific heats and the allotropy of nickel between 0° and 1,000° C.

W. BLEEKER : Meteorological observations on the three Dutch Karakorum expeditions (2).

L. ALGERA : Concerning the influence of temperature treatment on the carbohydrate metabolism, the respiration and the morphological development of the tulip (1).

A. VAN DER MEULEN and IDA LUYTEN : Comparison of the young organs of Spanish, English and Dutch irises.

H. GERTH : The occurrence of isolated calicular plates of *Dinocrinus* in the Permocarboniferous of Australia and India and its stratigraphical significance.

J. ARIËNS KAPPERS : Brain-body weight relation in human ontogenesis.

N. SUZUKI : The diencephalic and some other systems in *Xantharpyia amplexicaudata* (2).

C. H. WADDINGTON and J. NEEDHAM : Evocation, individuation and competence in amphibian organizer action.

N. POSTMA : Shape and slope of rest curves of the stretched foot of the snail (*Helix pomatia* L.) in relation to its water content.

G. P. FRETS : The heredity of the size and the form of the seeds of *Phaseolus vulgaris*. The segregation of the F_2 generation.

Brussels

Royal Academy (*Bull. Classe Sci.*, 32, 8–9 ; 1936).

TH. DE DONDER and MISS Y. DUPONT : New theory of the dynamics of continuous systems.

F. H. VAN DEN DUNGEN : Application of Bessel functions to the calculation of solid angles.

L. GODEAUX : Remark on the surfaces of genus zero and bigenus one.

F. SWARTS : Contribution to the study of the action of bromine water on ethylenic compounds. Action on cyclohexene.

J. GÉHÉNIAU : Reduction of the second variation.

P. GILLIS : Certain classes of partial differential equations.

D. S. MITRINOVICH : Asymptotic lines of a class of surfaces.

L. LISON : Histochemical fixation of mineral elements of tissues.

C. PAUC : Introduction of directions in a metrical space. Analysis of the contingent and of the paratingent from the point of view of topology.

Cape Town

Royal Society of South Africa, July 15.

J. S. GRIFFITHS : Women's initiation among the Mpondo. Descriptions from native sources and observation of the ceremonies observed at the initiation from girlhood to womanhood among the Mpondo.

A. J. H. GOODWIN : The Mpondo regimental system. An account of the regimental system of the royal houses of the Western Mpondo.

August 19.

J. A. GILMORE : Young's modulus for steel surveying bands. Steel bands hanging in catenary loops between supporting stands are employed in Jaderin's method of measuring base lines. An investigation into the technique of using bands in this way is being carried on in the Surveying and Civil Engineering Departments of the University of Cape Town. An extensometer was used for finding the elastic constants. For steel bands approximately 1/8 in. wide by 1/64 in. thick, the yield point occurred at a stress in the neighbourhood of 53 tons per square inch, while the ultimate stress was approximately 108 tons per square inch. The value of Young's modulus for the same steel was 28,000,000 lb. per square inch.

N. H. ROBERTS : (1) Some studies of 50 cycle wave-forms in insulation testing. An experimental investigation is described of the factors which influence the wave-form of a particular 30 kilovolt testing transformer. The tests show that, if the capacity of the load is limited, a reasonable amount of resistance regulation combined with the use of an induction regulator will yield reliable results except at the lower readings. A calibration based on a knowledge of the crest factor at all settings is necessary. (2) A device for the superposition and simultaneous delineation of two wave-forms on a single cathode ray oscillograph screen. The paper describes a device in which the two wave-forms are applied alternately, being interchanged 20,000 times per second, and in which the waves may be superposed. Transient phenomena may be studied, and slight differences in wave-form readily shown up.

W. G. SHARPLES : Rock engravings near Beaufort West.

M. A. POCOCK : Studies in South African Algæ : *Hydrodictyon* in South Africa (1).

Sydney

Royal Society of New South Wales, August 5.

G. J. BURROWS and A. LENCH : (1) Co-ordination compounds of cadmium with tertiary arsines. (2) Derivatives of zinc halides with tertiary arsines.

G. H. HALLIGAN : The causes of ice ages. This is a critical review of the literature on the subject since the year 1864. The question is treated in a new way, the fundamental facts regarding geology, astronomy, oceanography, physics, geography and meteorology, which must be adhered to, being first stated, and the writings judged by the standard thus obtained. The main difficulties encountered are those due to the action and reaction of physical agents brought about by complete changes of atmospheric and oceanic currents, due to cosmical causes. It is believed that no salient fact has been brought forward which vitiates Dr. J. J. Croll's theory advanced in "Climate and Time" in 1890.

A. BOLLIGER : The reaction of creatinine with 1,3,5-trinitrobenzol, 2,4,6-trinitrotoluol, and 2,4,6-trinitrobenzoic acid. Until recently, picric acid was the only colour reagent available for the determination of creatinine. Then it was found that 3,5-dinitrobenzoic acid also gives a useful colour reaction with creatinine ; now it is shown that 1,3,5-trinitrobenzol, 2,4,6-trinitrotoluol and 2,4,6-trinitrobenzoic acid react in a similar way. Trinitrobenzol and trinitrobenzoic acid give a red colour with creatinine in alkaline solutions. These reactions are analytically useful, while trinitrotoluol furnishes a colour reaction which is not sufficiently marked for such purposes. All these colour reactions of creatinine have been explained as the formation of organic molecular compounds.

H. FINNEMORE, SUZANNE K. REICHARD and DOROTHY K. LARGE : Cyanogenetic glucosides in Australian plants (5). *Phyllanthus gasstroemii*.

G. J. BURROWS and A. LENCH : (1) Derivatives of zinc halides with tertiary arsines. Zinc halides were found to react fairly readily with phenyl dimethyl arsine, diphenyl methyl arsine and *o*- and *p*-tolyl dimethyl arsines to give crystalline compounds which were found to be deliquescent like the zinc halides themselves. The iodides were found to be the most stable. With the exception of the compound $Zn(PhMe_2As)Cl_2$, the compounds isolated contained one molecule of zinc halide co-ordinated with two of arsine. (2) Co-ordination compounds of cadmium with tertiary arsines. The authors describe compounds formed by cadmium halides with phenyldimethyl arsine, diphenyl methyl arsine and *o*- and *p*-tolyl dimethyl arsine. The compounds are all crystalline, possessing characteristic melting points which decrease from chloride to iodide. With the exception of $Cd(Ph_2MeAs)_2I_2$, in which two molecules of arsine are co-ordinated with one of cadmium iodide, all of the compounds isolated contained one molecule of arsine to one of cadmium halide.

Forthcoming Events

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

Monday, November 9

ROYAL GEOGRAPHICAL SOCIETY, at 5.—N. E. Odell: "The Glaciers and Morphology of the Franz Josef Fjord".

UNIVERSITY OF LEEDS, at 5.15.—Prof. A. M. Carr-Saunders: "Population Situation in England".*

Tuesday, November 10

ROYAL COLLEGE OF PHYSICIANS, at 5.—Dr. J. D. Rolleston: "The History of Scarlet Fever" (FitzPatrick Lecture).

IMPERIAL COLLEGE—ROYAL SCHOOL OF MINES, at 5.15.—Philip Rabone: "Modern Methods of Flotation" (succeeding lectures on November 17 and 24).*

ILLUMINATING ENGINEERING SOCIETY, at 7.—(Joint meeting with the Institution of Engineers-in-Charge at the Institution of Mechanical Engineers, Storey's Gate, St. James's Park, S.W.1).—E. W. Murray: "Factory Lighting and Accident Prevention".

PHARMACEUTICAL SOCIETY, at 8.30.—Dr. Donald Hunter: "Industrial Toxicology of To-day".

Wednesday, November 11

INSTITUTE OF PHYSICS, at 8.—L. C. Nickolls: "Physics and the Detection of Crime".

Thursday, November 12

ROYAL SOCIETY, at 11 a.m.—Discussion on: "Chemical and Physical Basis of Pharmacological Action" to be opened by Prof. A. J. Clark, F.R.S.

BRITISH SCIENCE GUILD, at 4.30—(at the Goldsmiths' Hall, Foster Lane, E.C.2).—Lord Rutherford: "Science in Development".*

ROYAL AERONAUTICAL SOCIETY, at 6.30—(at the Royal Society of Arts, 18 John Street, Adelphi, W.C.2).—Dr. F. W. Lanchester, F.R.S.: "The Part played by Skin Friction in Aeronautics".

Friday, November 13

ROYAL SOCIETY OF ARTS (INDIAN SECTION), at 4.30.—Dr. J. H. Hutton: "Head Hunters of the North-east Frontier".

SOCIETY OF CHEMICAL INDUSTRY (LONDON SECTION), at 6—(at the Institution of Civil Engineers).—Dr. J. W. Mellor, F.R.S., and A. T. Green: "Refractory Materials" (Jubilee Memorial Lecture).

Official Publications Received

Great Britain and Ireland

Imperial Agricultural Bureaux. Herbage Publication Series, Bulletin No. 18: Pastures and Forage Crops in South Africa. Contributions by I. B. Pole Evans, A. R. Saunders, J. W. Rowland and S. R. de Villiers. Pp. 31+4 plates. (Aberystwyth: Imperial Bureau of Plant Genetics.) 3*s*. [1910

Technical Publications of the International Tin Research and Development Council. Series A, No. 44: Micro-Plasticity in Crystals of Tin. By Dr. Bruce Chalmers. Pp. 20. Free. Series A, No. 45: The Retarding Effect of Stannous Salts on the Oxidation of Olein and Oils. By Dr. Ir. S. H. Bertram. Pp. 10. Free. (London: International Tin Research and Development Council.) [2010

Survey of Thunderstorms in the British Islands. British Thunderstorms, containing Summer Thunderstorms. Fourth Annual Report, 1934. By S. Morris Bower and others. Vol. 2, Part 1. Pp. 48+viii+4 plates. (Huddersfield: Thunderstorm Census Organization.) 2*s*. 6*d*. [2110

Society for Preservation of Old Sheffield Tools. A Glossary of Words and Dialect formerly used in the Sheffield Trades. Part 1. Compiled and edited by B. Ronald Dyson. Pp. 56. (Sheffield: Society for Preservation of Old Sheffield Tools.) 1*s*. 3*d*. [2210

Other Countries

Académie des Sciences de l'URSS. Travaux du Congrès Jubilaire Mendeléev. Vol. 1. Pp. v+666+16 plates. (Moscow et Leningrad: Académie des Sciences de l'URSS.) [1910

Obras completas y Correspondencia científica de Florentino Ameghino. Vol. 22: Correspondencia científica. Edición Oficial ordenada por el Gobierno de la Provincia de Buenos Aires. Dirigida por Alfredo J. Torcelli. Pp. 710. (La Plata.) [1910

Annual Report of the Imperial Council of Agricultural Research for 1935–36. Pp. iv+110. (Delhi: Manager of Publications.) 14 annas; 1*s*. 6*d*. [1910

Government of India: Meteorological Department. Magnetic, Meteorological and Seismographic Observations made at the Government Observatories, Bombay and Alibag, in the Year 1934 under the direction of Dr. S. C. Roy. Pp. xiv+136+5 plates. (Delhi: Manager of Publications.) 10.4 rupees; 17*s*. [1910

Annual Report of the All-India Institute of Hygiene and Public Health, Calcutta, 1935. Pp. 57+5 plates. (Calcutta: Government of India Press.) [1910

Osiris. Vol. 2, Part 1: Sir Thomas Little Heath. By David Eugene Smith. Pp. xxvii+1 plate. Vol. 2, Part 10: Jan Evangelista Purkyně (Purkinje), 1787–1869. By O. V. Hykeš and F. K. Studnička. Pp. 464–483+1 plate. Vol. 2, Part 11: The English Plague Scare of 1820–23. By Charles F. Mullett. Pp. 484–516. Vol. 2, Part 12: Jahrszeiten und Tageslängen in der babylonischen Astronomie. Von O. Neugebauer. Pp. 517–550. (Bruges: The Saint Catherine Press, Ltd.) [1910

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