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Research and Teaching in Universities

ONE of the most impressive passages in the recent report of the University Grants Committee is that in which attention is directed to the opportunity of service before the universities to-day in training the right type of leader, competent to think strenuously about great issues of right and wrong, liberty and government, and to bring to the grave problems of to-day minds richly informed and unsleeping in the exercise of critical intelligence, and imaginatively alive to the human issues underlying the decisions they are called upon to make. In an age when appeals to mass hysteria often appear to be more successful than appeals to reason, it is of the utmost importance that a university training should enhance a man's equipment not only as a skilled worker but also as a member of society and a human being.

The desirability of closer contact between the universities and the life of the community was also emphasized in speeches at the banquet on June 29 in connexion with the centenary celebrations of the University of London. Prof. L. Cazamian, of the University of Paris, referred to the function of the university in developing the unselfish love of peace, and a creative instinct of fair play to all the nations. The slow victory of a ripe spirit of justice over the promptings of blood, life and force is a subject for noble pride that something of the will to power of past ages might be sacrificed to a new hope and a new faith.

In a speech on the same occasion, Sir James Barrett directed attention to the value of a university as a place where a problem could be discussed without being overlaid by political and financial considerations. A university, however, cannot speak in the collective sense, and if a professor speaks individually he is apt to be criticized

if his notions do not agree with those of some of his hearers. Sir James Barrett suggested that the function of universities as a whole to meet the crying need of a world in constant travail is the production of men with balanced minds, organized intelligence and common sense.

This plea that the universities should no longer be regarded as unco-ordinated centres of specialized knowledge, but should come into closer contact with social problems and give an enlightened lead to the community independently of political parties, has frequently been advocated in different ways during recent years. Essentially it involves two separate questions. The first is the impartial study of social and economic questions, as has been carried out in recent years by the Research Section of the Department of Economics and Commerce at the University of Manchester under the leadership of Mr. John Jewkes. The second is the training of leaders for the community who possess the vision and personality to compel action along the lines indicated as a result of such investigations.

In regard to the first, Sir James Barrett suggested that some system of interlinked university research throughout the world, on the lines of that developed internally in the Commonwealth of Australia under the Council of Scientific and Industrial Research, is required. Without an educated public, however, it is almost impossible to ensure that the results of such investigations are fully utilized for the advantage of the community.

The problem is thus one of education and teaching as well as research or investigation, and the question of the right relation between teaching and research in the universities is one of the most important of those raised by the recent report of

the University Grants Committee. It has since been discussed in a valuable article by Dr. R. Coulborn in the *Nineteenth Century*, and reference was made to the same problem by the Prime Minister in opening the fifth Congress of Universities of the British Empire at Cambridge on July 14.

Unquestionably one of our first needs is the re-orientation of research at the universities, and the institution of research in the biological sciences and the humanities, so that we may be in a better position to deal with the many social problems with which the unparalleled and disproportioned development of the physical sciences has confronted us. In such work the prime need is for creative research, and Dr. Coulborn does well to remind us that much research work can be, and is, undertaken without any preceding act of creation. In fact, the patience, dexterity and precision demanded in so much research to-day tend to blunt the enthusiasm, imagination or vision of the investigator. He tends to become a machine, and cannot easily escape some warping of his mind or loss of humanity.

These effects of specialization cause the research worker to lose interest in teaching, and it is for this reason rather than to free the investigator from other distractions, as Mr. Baldwin suggests, that some reconsideration of the close connexion between research and teaching which at present exists in the universities is desirable. Undoubtedly it is true that the investigator of genius, the man with really creative ability, should be free from other claims on his time so far as possible. It is equally true that he is likely to be lacking in the patience which research demands, and will require a number of other workers to carry out the detailed work along the lines his genius suggests. It may also be true that his creative ability will be combined with a capacity for inspiring enthusiasm in others and thus for some measure of teaching, which is the fundamental reason for believing that the university teacher should himself be engaged in original work in his subject.

Such men, however, will always be the exceptions, and Dr. Coulborn's warning as to the damaging effects of research in university education cannot be lightly disregarded. He considers that the numbing influence of research on character destroys the teacher's ability to interest and inspire, while undergraduate studies are also usually planned on a basis of progressive narrowing down towards research minutiae instead of being

such as to offer the student the deepest understanding of his subject. If we accept the view urged by Mr. C. H. A. Wilson, vice-chancellor of the University of Cambridge at the recent Universities Congress, that the universities are national and imperial institutions, and that it is their duty to train against a background of pure scholarship men and women who are fitted to take a lead, or at any rate a creditable part, in the conduct of social, commercial and political administration, the question of the quality of the teaching given acquires primary importance.

The evidence cited by Dr. Coulborn suggests that our present practice of linking teaching and research is inefficient even from the point of view of research, and that much superior results would be obtained if the functions of research and teaching were entirely separated and made full-time occupations. Not only is it probable that teaching would be more effective and inspiring and more adapted to the social needs of the student if such a division were effected, but also it would be easier in the transition to secure a re-orientation and direction of academic research in the fields in which it is most demanded by the needs of the community. Moreover, a check would be given to that untoward tendency for undergraduate training to approximate to a soul-destroying professional training instead of the training in scholarship, in strength of character, and in potentialities of good citizenship, which it should be the glory of a university to give as a preliminary foundation of professional training.

There need be no fear that such a separation of functions would lead to any debasement of research. On the contrary, it is more likely to enhance its repute if the conduct of research is a full-time activity of investigators appointed for the purpose rather than the part-time activity of a lecturer or an aspirant for a higher degree. The prestige of research could only be enhanced by being placed on a footing which would enable its real leaders and men of genius to direct and inspire the large army of patient investigators whose co-operation is so essential in any advance to-day.

One of the most important consequences of such a separation of functions would equally be the encouragement which could be given to the really great teacher with a genuine talent for exposition and inspiring others. Such teachers, though teaching may be their whole occupation, will never fail of that constant refreshment at the fountain heads of knowledge which is essential if their

teaching is to retain its freshness and vitality. The present interrelation of research and teaching, in fact, has few more untoward consequences than the way in which it tends to diminish the prestige or status of such expositors who, whether within the walls of a university or in the nation at large, are one of the greatest needs to-day. Only through the work of sincere, able and fearless expositors can we hope that either the alumni of our universities will awake to the vastness of their opportunities of leadership and constructive service in the world to-day, or humanity at large realize how great are the benefits which the acceptance of such

leadership could confer upon them. The separation of teaching from research in such ways as these may well advance the dignity of both, and enable the universities to make an ever-growing contribution to our national and imperial well-being. This service will be rendered alike through the provision of exact and impartial knowledge and analysis of the factors concerned in many of our grave social or economic problems to-day, and in the training and inspiring of those who can bring to bear upon them constructive criticism, moral courage, a wide vision and a keen sense of human values.

Native Agriculture in Africa and its Relationship to Population

The Improvement of Native Agriculture in relation to Population and Public Health

By Sir A. Daniel Hall. (University of London: Heath Clark Lectures, 1935, delivered at the London School of Hygiene and Tropical Medicine.) Pp. vii+104. (London: Oxford University Press, 1936.) 10s. 6d. net.

IN this book, Sir Daniel Hall deals with some of the many problems which have arisen from the impact of modern civilization on the native tribes of Africa. The increase in the human population and in the number of cattle which followed the stoppage of war and the reduction in epidemic disease has led to a dangerous condition—"The eminent consequences are disease due to inadequate diet, tribal unrest and the spread of the desert".

Primitive native agriculture is carried on by the method of 'shifting cultivation'. A piece of bush or forest is burned, and the ashes scattered. On this virgin soil crops are grown for one or two years, by which time the land is overrun by weeds. It is easier to burn another area than clear the weeds and fertilize the soil, so a further area of primitive jungle or forest is burned. So long as the population was small, Nature could repair the damage at leisure. But the population has increased to such an extent that regeneration no longer keeps pace with destruction. Apart from the increase in the population, the process of destruction is increasing owing to the growing of cotton and other products by the native for sale.

To the destruction of the land by the natives there is added the destruction by domestic animals. The increase in the number of cattle, sheep and

goats has upset the balance between the grazing animal and the pasture. The pasture gets eaten down to the very roots, and even the roots are destroyed by the goats. On the slopes, the tropical rain washes away the top fertile soil, no longer bound by the mat of vegetation. There results an area completely denuded of vegetation. In this way the desert is steadily spreading. This is a problem which is not confined to East Africa. Soil erosion due to over-stocking has become a most serious problem in various parts of the world.

Unfortunately, the native will not sell his cattle. The wealth and prestige of the family and the tribe depend upon the number of cattle, and the possession of cattle is interwoven with the social and religious structure of native life. Cattle, sheep and goats are, to the African native, even more important than money is to the modern European. Immense numbers are kept quite independently of their value for food or any useful purpose, except the maintenance of wealth and prestige. It will be exceedingly difficult to demonetize cattle in East Africa.

Associated with the problem of the growing population with decreased fertility of soil, is the widespread occurrence of malnutrition. Inadequate diet is one "if not the chief source of disease among African natives". If the health of the native is to be improved, the improvement must begin with better food.

After reviewing the present conditions and showing how they have arisen, the author in the final chapter suggests what should be done to prevent "famine and the spread of desert" replacing war and pestilence, as a means of reducing the

population. The essentials of a new system are: "(1) the replacement of shifting cultivation by a fixed agriculture which will maintain continuous production from a smaller area, leading to a more balanced dietary; (2) the elimination of excessive live stock and the utilization of the remainder to provide food; (3) the prevention of soil erosion and the reconditioning of the devastated areas".

Sir Daniel Hall has brought to bear on this problem of East Africa his great fund of biological scientific knowledge, and his long administrative

experience. The results of his study given in this book are an interesting illustration of the value of approaching political and economic problems from the point of view of the man of science, who is accustomed to dealing with ascertained facts rather than preconceived political ideas.

This book should be read not only by those who are interested in the great problem of the native races of Africa, but also by those interested in the application of science to present-day world-wide problems of economics. J. B. ORR.

Concentrated Solutions

Les solutions concentrées:

théorie et applications aux mélanges binaires de composés organiques. Par Prof. Jean Timmermann. Pp. vi + 646. (Paris: Masson et Cie, 1936.) n.p.

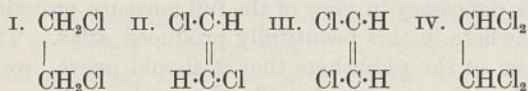
FIFTY years ago, important advances were made when Arrhenius and van't Hoff made their classical studies on the conductivity and osmotic pressure of aqueous solutions; but the rules which they established were valid only for dilute solutions, and in most cases were rigidly true only at dilutions at the extreme end of the range, where the percentage of the solute is only a very minute fraction of the whole. Prof. Timmermann's book, on the other hand, is concerned with those solutions in which the two components are present in comparable quantities. Its scope is indicated by the exclusion of all systems for which there are no data between 10 and 90 gm. per cent, or only one datum between 10-20 per cent or 80-90 per cent. A sub-title also restricts the book to "theory, and applications to *binary* mixtures of *organic* compounds".

Even with this limitation, the data occupy a volume of 600 pages, which is illustrated by a series of 540 figures, many of which include more than one property in the same figure. The book is, however, by no means a mere dictionary, since it begins very happily with a fascinating account of the admixture of compounds the molecules of which are mirror images of one another. Seven diagrams show the freezing points of mixtures of *d*- and *l*-forms of various optically active compounds, some of which (for example, methyl tartrate and butyl phthalate) form a crystalline racemate with a higher melting point than either of the active components, whilst others (for example, phenylglycollic acid) form a less stable racemate of lower melting point. In other cases again, the *d*- and *l*-forms are isomorphous, and

yield 'solid solutions' in all proportions, as in the remarkable case of *d*- and *l*-camphoroxime, or within narrower limits of miscibility. The difficult question of the existence or persistence of racemic compounds in the liquid state is answered in the affirmative in certain instances by a study of the experimental data now cited.

The second chapter of the book extends this study to mixtures of *isomers* which are not mirror images of one another, but differ either in configuration (stereoisomers) or in constitution, and of *polymers* which differ also in molecular weight. In this series of mixtures a clear distinction is drawn between (a) *static isomers* (or polymers) where, in spite of their identity of composition, each component is a stable well-defined compound, yielding true solutions when mixed, such as propionaldehyde and acetone, or acetylene and benzene; (b) *dynamic isomers* (or polymers) which behave as static isomers in the absence of a catalyst, or in presence of a negative catalyst, but undergo reversible change in presence of a positive catalyst, such as acetaldehyde and paraldehyde in presence of sulphuric acid; (c) *tautomers*, to which more than one molecular structure can be assigned, but which are too mobile to be separated into two constituents, such as (i) 1:2 and 1:6 dichlorobenzene, or (ii) stereoisomers which are interconvertible by free rotation about a single bond. Examples which are cited of the group of interconvertible isomers include (i) the dichloroacetylenes studied by Chavanne (and seven other pairs of olefines) which are interconvertible when pure, but can be stabilized by the addition of alcohol, (ii) ten pairs of interconvertible stereoisomers, including two pairs of oximes and the classical examples of fumaric and maleic acids, (iii) acetaldehyde and paraldehyde, (iv) ammonium sulphocyanide and thiourea, studied in very full detail by Werner in Dublin.

In the third chapter of the book, the compounds which are mixed need not be identical in composition, provided that they are sufficiently similar to form isomorphous mixtures. In this field the author (following Bruni) has himself done important work. Thus, in spite of free rotation in the liquid state, ethylene dichloride (I) evidently takes up preferentially a *trans*-configuration, since it forms mixed crystals with the *trans*-form II of dichloroethylene, but a eutectic with the *cis*-form III of this compound, the configurations of which are fixed by the presence of a double bond.



On the other hand, he has discovered, *inter alia*, that ethylene dichloride (I) forms an equimolecular compound with the symmetrical form of the tetrachloro-compound, IV. The formation of equimolecular aggregates of this type is attributed to the preferential packing of complementary molecules of I and IV, in just the same way that an equimolecular mixture of *d*- and *l*-tartaric acids forms a more stable aggregate than either type of molecule separately. In order to recall this analogy, the equimolecular mixtures are described as "racemoids".

The fourth chapter of the book deals with mixtures of substances of similar type, for example, homologous hydrocarbons, alcohols, esters and amines, substitution products such as $\text{C}_2\text{H}_4\text{Cl}_2$ and $\text{C}_2\text{H}_2\text{Cl}_4$ or *di*- and *tri*-nitrotoluene, and mixtures of compounds with unequal numbers of aromatic rings, such as the binary mixtures formed by benzene, naphthalene and anthracene.

In the preceding systems, which form Part I of the book, analogy of structure between the components often produces simple relations in the physical properties of the mixtures, although this

is very far from being universally true. Part 2, on the other hand, deals with components of different chemical types, and Part 3 with systems in which one of the components includes a hydroxyl group. The relationships are now more complicated, and long tables are given of mixtures which are 'azeotropic', because they form mixtures of minimum (or more rarely, maximum) boiling point. (The introduction of the term by Wade and Merrimann in 1911 is cited on p. 159.) Shorter lists are also given of pairs of substances which yield two liquid layers at temperatures below the 'critical solution temperature'. Even in these more complicated sections, however, the book never reverts to the status of a mere catalogue, since the reader will find various special subjects, such as the influence of solvents on optical rotatory power, or the behaviour of systems containing anisotropic liquids, adequately discussed, with diagrams and references to the original literature.

The bibliography at the end of the book covers 26 pages, papers published in the same year being given a serial letter, for example, 1914 *b*, which (with the date) suffices to define the reference. The mixtures are indexed in the sequence of formulæ used in Richter's "Lexicon", beginning with methane, CH_4 , and ending with tristearine, $\text{C}_{57}\text{H}_{110}\text{O}_6$, the component with the simpler formula in Richter's sequence being chosen for the primary entry in the index. The second component of the mixture is then indexed in the same sequence under the first component. Since the formula of each component is accompanied by the name of the compound in question, isomers are always grouped together but are clearly distinguished from one another.

The book as a whole is a monument to the patience and skill of the author, who has rendered a real service to his colleagues by undertaking so formidable a task for their benefit. T. M. L.

A New 'Oxford Atlas'

The Oxford Advanced Atlas

By John Bartholomew. Fifth edition. Pp. iv+96+32. (London: Oxford University Press, 1936.) 10s. 6d. net.

THE outstanding feature of the new "Oxford Advanced Atlas" is a larger page with larger maps. This has allowed of the introduction of double-page maps of the Iberian Peninsula and the Balkan States. With their inclusion, the atlas now shows the whole of Western, Central, and Mediterranean Europe on the 1:3,000,000 scale.

There are also new double-page maps of the U.S.S.R., South-West Asia, the Malay Archipelago, the Laurentic Basin, Central and East Africa, and South Africa.

The atlas is thoroughly up-to-date. The "Sarre" of previous editions has become the "Saar", with the former northern and eastern frontier lines deleted. The new and highly significant railway links between Polish Silesia and Gdynia are shown, and British coal exporters as well as Danzig shippers are likely to be affected by them. The map of the Soviet Union is especially useful, since

it emphasizes the essential unity of the European and Asiatic territories of Russia, and their relationship to the marginal lands of Mongolia and Manchukuo. Moreover, it is now possible to locate much-advertised names like Gorki, Dnieprostroy, and Magnitogorsk.

Mercator's projection has been banished from the atlas, except in an illustration on the pages devoted to map projections in general, and the atlas now lacks a serviceable map of world shipping routes. The world political and population maps are drawn on a new equal-area projection termed the Re-Centred Sinusoidal. This shows the land areas true to scale with a minimum of distortion. There is also a valuable map on the morphology of Europe, embodying a more precise classification of the relief features (on the basis of structure) than has hitherto obtained.

In the case of the British Isles, what are described as "the rather elementary county-coloured maps of the earlier editions" have been omitted. One result is that the atlas lacks a satisfactory map of the counties of the British Isles, which seems a pity in view of our strongly developed territorial sense. Another result is that many places found in previous editions do not occur in the present one. To give a test case—the fourth edition marks nineteen places in Hampshire and the Isle of Wight which do not occur in the present edition. It would be ungracious, however, to labour this deficiency in view of the full measure provided elsewhere in this beautifully produced atlas. The claim of the publishers that it should prove "well-nigh indispensable to all who wish to take an intelligent interest in the world they live in" is justified. It definitely supersedes previous editions.

Fish and Fishing

(1) **Letters to a Salmon Fisher's Sons**
By A. H. Chaytor. Fourth edition. Pp. xxviii + 316 + 8 plates. (London: John Murray, 1936.) 9s. net.

(2) **Sea Trout and Trout**
By W. J. M. Menzies. Pp. 230 + 16 plates. (London: Edward Arnold and Co., 1936.) 10s. 6d. net.

(3) **Trout Heresy**
By P. B. M. Allan. Pp. 206. (London: Philip Allan and Co., Ltd., 1936.) 8s. 6d. net.

(1) **S**INCE the publication of the third edition of this well-known book, the author has died. It is, as its title suggests, in the form of a series of letters from an ardent salmon fisher to his sons. Presented in this way the information is simply, although adequately, set forth, and it is possible that the author's legal training has a great deal to do with the clarity with which he makes his points. It is evidently the result of long experience, and written in a manner that can be read by the beginner and more experienced angler with equal profit and enjoyment. The present edition is prefaced with a short sketch of the author by Mr. A. Drewett Chaytor, one of the sons for whom the letters were originally written.

(2) Mr. Menzies, the author of "Sea Trout and Trout" is particularly well qualified for his task. As inspector of salmon (including trout) fisheries for Scotland, he has access to the literature of the many researches that have been conducted in this field. During the past fifteen years a great deal has been done in various countries, but particularly

in Scotland, to extend our knowledge of the life-history and habits of the trout, and in this work the author has taken a prominent part. In addition, he is an enthusiastic fisherman with an exceptionally wide knowledge of all the Scottish waters. Thus in telling his story he is able to utilize the most recent information to illustrate those points in which the ordinary naturalist and the angler are interested, and he has achieved considerable success.

The modern view is that sea-trout and trout are simply the migratory and non-migratory races of the same species. After some general chapters the book passes on to the life-history of the two races, from the spawning in the redd, through the smolt, whiting and kelt to the old fish again, and the various problems connected with each of them are succinctly dealt with. Such problems include the determination of age from the scales, the food, the results of marking experiments and the seasonal movements. The concluding chapters treat of diseases, abnormalities, parasites, homing instinct and the making and preserving of a sea-trout fishery.

The book is furnished with an index and a short but useful bibliography; it is well illustrated and printed. The straightforward manner in which it is written should give it a wide appeal.

(3) This volume approaches the problem of fishing from yet another point of view, for the first treats of the art of catching fish, the second of the science of their lives and the third of the psychology of the fish and, by inference, that of the fisherman. The author examines the physical

and more particularly the mental equipment of the trout, its senses and their modes of action. This is done in the light of comparative psychology to a considerable extent, but also in the light of a great deal of actual observation by the author and other experienced anglers.

Certain writers tend to endow the trout with almost superhuman attributes, an attitude explained thus: "The rest of the truth is that be we never so skilful, boast we half a century of experience, we can catch trout but little more easily—if at all—than when we were striplings. There *must* be something in it—quite obviously trout are extremely cunning fish." A quotation from such a eulogy serves as an excellent Aunt Sally to be knocked down by the author with consider-

able gusto. What are the parts played by instinct and intelligence in this cunning? Can the fish profit by experience? Why do they rise? To what extent are they capable of distinguishing flies or other bait? Why are there often two types of trout in the same water? These and other problems that have been pondered by fishermen since first a fly was cast or a minnow spun, are treated in an engaging manner which never becomes tedious or didactic, although the opinions put forward are well documented by footnotes. The pure dry-fly man comes in for some delightful gibes, but they are always kindly and never sneering. It is just the book for the fisherman to take with him on his trip, for he will find in it much food for thought and new side-lights on old problems.

Review of Biochemistry

Handbuch der Biochemie des Menschen und der Tiere

Herausgegeben von Prof. Dr. Carl Oppenheimer. Zweite Auflage. Ergänzungswerk, Band 3. Pp. xxiv+1162. (Jena: Gustav Fischer, 1936.) 84 gold marks.

IN previous reviews of this Brobdingnagian offspring (see NATURE, 133, 595; 1934; and 135, 287; 1935) we have already commented on its dimensions and the deducible dimensions of its parent. In this third volume of the "Ergänzungswerk" to the second edition of the "Handbuch" we have 1,136 pages of text and 25 pages of index, giving a total almost identical with that of the first volume; this was, however, published in two half-volumes of about 600 pages each, and there is no clue to the reason for the production of this monster between a single pair of covers.

This third volume is supplementary to vols. 7-9 (Parts 8-10) of the main volume. It covers metabolism under special conditions, including the processes of birds, cold-blooded animals, and invertebrates; metabolism under physiological conditions, including growth, pregnancy, heavy labour, hunger and under-nutrition, variations of climate, and radiation; metabolism under the influence of secretions and of endocrine disturbances; metabolism under various pathological conditions, including fevers, nervous disturbances and deficiency diseases; and the metabolism of the female generative system. These various sections constitute the supplementary material to Part 8 of the main volume.

The supplementary material to Part 9 is concerned chiefly with the metabolism of particular

organs and tissues, including tumour tissue, and with the metabolism of the various essential food constituents, water, minerals, carbohydrates, proteins, creatine and creatinine, nucleides, fats and lipoids. Part 10 is supplemented by a survey of all those subjects that are comprised under the general phrase "Regulation of Function"—including both non-specific (for example, nervous) and specific regulation, as by vitamins and hormones. The section here on the biochemistry of the sexual hormones is, incidentally, described in a note as itself supplementing Dr. Butenandt's contribution to the first supplementary volume, published in 1933—a clear demonstration of the exceptionally rapid progress now being made in the field. Separate sections in the supplement to Part 10 are devoted to the physiology of the various endocrine organs. Finally, there is a useful addendum on the sterols, bile acids, and inositol.

As in the previous supplementary volumes, the names of many of the contributors are biochemical household words. Avon, Krüger, Lehmann, Pincussen, Felix, Fürth, Grafe are among the professorial contributors, supported by a number of *Privat-Dozenten* to a total of some twenty. This volume completes the task of supplementing the "Handbuch's" second edition. It maintains the authoritative character of the other two volumes and constitutes with them a quite indispensable whole.

Words almost fail one at the scope and completeness of the "Handbuch" and the supplementary volumes. If a reviewer may be permitted to repeat himself, it can once more be stated that "these volumes are of the kind that fill the user with awe-inspired gratitude and the reviewer with awe-inspired terror".

A. L. BACHARACH.

A Pilgrim's Quest for the Divine

By Lord Conway of Allington. Pp. 255. (London: Frederick Muller, Ltd., 1936.) 10s. 6d. net.

LORD CONWAY'S book reminds one of a philosophical romance such as "Rasselas", or even "John Inglesant". Much of it is in dialogue, and the scene passes from place to place—Switzerland, Italy, the Andes, Spitsbergen. The writer has been a pilgrim in the physical as well as in the spiritual sense. This is not a systematic treatise; but readers can go on with interest, and take the ideas as they come—they are always suggestive and often ingenious. Not that it is a casual book, for it has been rewritten four times, the author tells us, and he is working out his point of view all the while.

The problem with which the book is largely concerned is that of time and its relation to eternity, especially in the light of the theory that time is a fourth dimension of space. Lord Conway asks whether this conception may not "involve an entire revolution in our ideas about both the present and a possible so-called future life". His theory is that we are living and active in a three-dimensional state which exists within a four-dimensional universe. As we pass through the latter (as a two-dimensional inhabitant of Flat-land might pass through our three-dimensional world), "we leave behind us in what we regard as the passage of time the result of our actions built into the structure of our lives". This enables Lord Conway to envisage something in the nature of the Pauline conception of a "spiritual body", built up by a life's activities much in the way that a crystal is built up.

The last pages of the book consist of extracts from a diary kept by the author while staying with a small Franciscan community on an island near Venice. These are of particular interest, and the author seems to plead for something in the nature of a modern Third Order of St. Francis.

"After all, St. Francis was not a mere visionary but a practical reformer. Why should not practical men of our day take up his work in a new form suitable for our present needs? Has not the passion for worm-eaten speculation yet made victims enough?"

The reader must come to this somewhat unconventional book with a sympathetic mind; but if he does so, he will find it very fruitful, even fascinating.

J. C. H.

Bibliographia Coleopterologica

Pp. xv+149-323. (Den Haag: W. Junk, 1935.) 10s.

THIS publication is a special cloth-bound catalogue issued by the well-known entomological publisher, Herr W. Junk, now of The Hague. While, in principle, it is a priced list of books, reprints and journals, bearing, in the main, upon insects of the order Coleoptera, in reality it serves a much wider purpose. It is, in fact, a partial bibliography of the order, which is accompanied by a most useful index, so arranged with cross-references that publications on practically every aspect of the order can be readily found. It is intended also to serve the purpose of

marking the jubilee of Herr Junk's most famous publication, the "Coleopterorum Catalogus", which was begun in the year 1910.

An interesting preface by S. Schenklung discusses the origin, history and purpose of this great work. The "Catalogus", which is now nearing completion, is the largest single work ever published dealing with the literature of any section of biology. It lists all the described species of beetles of the world, and the 141 parts (in twenty-one volumes), published to date, comprise 21,000 pages, containing the names, synonymy, distribution and taxonomic and biological literature of some 175,666 species. When completed, it will be comprised in thirty volumes, listing about 240,000 species in 134 families. The necessity for a reference work of this kind is borne out by the fact that its precursor—the Catalogue of Gimminger and Harold (1868-1876)—listed only 77,000 species.

A Comprehensive Treatise on Inorganic and Theoretical Chemistry

By Dr. J. W. Mellor. Vol. 15: Ni, Ru, Rh, Pd, Os, Ir. Pp. viii+816. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1936.) 63s. net.

VOL. 15 of "Mellor" includes nickel and five out of six elements of the platinum group. Only platinum itself remains, with a general index, to complete the final volume, which is described as "in the press". As the author's huge task approaches completion, the admiration called forth by its monumental character increases to a climax. For example, the reviewer was surprised to find his own name cited under nickel as joint author of a paper in which he himself had forgotten that this element was investigated. Such a thorough scouring of the literature can leave very few gaps to be filled up, and provides a wonderful guide to all the work done up to the date of compilation of the volume in question.

As in previous volumes, the dictionary aspect is relieved by occasional discussions, for example, on the atomic weight and valency of osmium, with special reference to the formulation of the tetroxide.

At this stage, no further commendation is needed, since in a short time the present notice will give place to congratulations when the final volume appears.

Einführung in die angewandte Akustik:

insbesondere in die neueren Probleme der Schallmessung, Schallübertragung und Schallaufzeichnung. Von Dr. H. J. von Braunmühl und Walter Weber. Pp. v+216. (Leipzig: S. Hirzel, 1936.) 9.20 gold marks.

FROM the physics point of view, this text is admirable. It covers most of the important applications of acoustics in the field of electrical communication, amongst which may be mentioned the measurement of performance of loudspeakers and microphones, the recording and reproduction of sound in its varied forms, acoustic perspective and the technical acoustics of enclosures. The last chapter appropriately deals with the measurement of fidelity of speech in communication systems, but the more difficult problem of measuring the fidelity in musical reproduction is not discussed.

L. E. C. H.

Polarization of Light and some Technical Applications

By Prof. A. F. C. Pollard

WHATEVER may be the nature of light, it is convenient to regard it as the propagation of an electro-magnetic disturbance in the ether. In an isotropic medium, free of electric charge, the electric and magnetic vectors are perpendicular to one another and to the direction of propagation. Either of these may be selected as the periodic vector—the light vector—associated with the disturbance, but it is usual to define the plane of polarization as that containing the magnetic force with the electric force perpendicular to it.

There are three fundamental qualities which are of major importance to the control of light.

The wave-length, which determines the frequency or colour and the amplitude upon which the intensity of light depends, are two of these qualities which have been under almost unlimited control for centuries. But the third—the direction and type of the transverse vibration—has continued to be under very limited control up to the present time only since 1669 when Erasmus Bartholinus observed the double-refraction of Iceland spar. A few years after the publication of Bartholinus's work, Huyghens indicated the distinctive character of the two beams transmitted by the spar, and Newton's discussion on the two-sidedness of the beams led to their subsequent description as polarized light. Curiously enough, this great discovery lay dormant as an isolated fact in science until about 1808, when Malus accidentally observed that the light reflected from the glass windows of the Luxembourg palace in Paris was polarized. Biot, making use of Malus's discovery, constructed his reflecting polariscope, which was one of the first devices to produce polarized light somewhat inefficiently by reflection.

It was not until 1828, however, that the optical anisotropy of Iceland spar was utilized by William Nicol as an efficient means for producing a plane polarized beam of light. With his famous prism, one of the beams—the ordinary ray—is shunted to one side, whilst the other—the extraordinary ray—is transmitted with but slight absorption as a pencil of wholly polarized light.

The working aperture of Nicol's prism, however, is limited by the size of optically perfect crystals of the spar, and the largest which has been made has an aperture of about 4 inches. Usually, nicols are much smaller than this, and even

moderately sized optically perfect crystals of the spar have already become scarce.

Commencing with Foucault in 1857 a number of investigators—Dove, Hartnack and Prazmowski, Jamin, Glan, Feussner, Zenker, Abbe, Ahrens, Silvanus Thompson and others—have devised various prisms with the object of taking every advantage to increase the aperture and economize the precious spar.

Nothing has yet been devised which equals the nicol for transparency and for the perfection of the polarization of the transmitted light; but when large apertures are required the only alternative has been the reflecting polarizer, which produces an imperfectly polarized beam with much loss of light. The recent work of E. H. Land, who makes use of the dichroic properties of certain substances, has, however, resulted in simple means for filtering out of common light a component with high percentage plane polarization by transmission through any sized aperture desired.

To understand Land's invention fully, it must be remembered that optical anisotropy may be manifest as double refraction in which the ordinary and extraordinary rays are transmitted with unequal absorption, when the difference of the coefficients of absorption may be called true dichroism.

The decrease in the intensity of the light when passing through an optically anisotropic plate may be partly due to scatter and partly due to true absorption. The difference of the coefficients of scattering is called 'dityndallism', and this with the true dichroism makes up the total dichroism. In most crystalline substances the dityndallism is negligible, but in colloidal anisotropic systems it may be important.

The absorption depends not only upon the thickness of the plate but also upon the wave-length, and consequently in nearly all dichroic crystals the transmitted light is coloured. The outstanding and historical example of a dichroic uniaxial crystal, in which the transmitted light is strongly polarized and nearly colourless, is tourmaline. In certain tourmalines the ordinary ray is completely absorbed, but the extraordinary ray vibrating in a plane parallel to the trigonal axis is transmitted unfortunately with so much absorption as to render most good polarizing tourmalines useless in feeble illumination.

In 1851 Dr. William Bird Herapath¹ discovered a remarkable compound of iodine and quinine sulphate, iodosulphate of quinine, $4\text{Qu}\cdot 3\text{H}_2\text{SO}_4\cdot 2\text{HI}\cdot \text{I}_4\cdot 6\text{H}_2\text{O}$, which aroused great interest at the time and was afterwards called Herapathite by Haidinger. Later, he discovered a similar dichroic compound of strychnine.

The double refracting Herapathite can be crystallized in minute hexagonal plates, and it has been stated that such a plate 1/200 inch thick will completely absorb one of the rays, permitting the other to be transmitted with scarcely perceptible absorption. Large crystals cannot be made, though some were made large enough by Dr. Herapath to be used by Beale as polarizing components in the microscope². These crystals were used for the microscope very shortly after their discovery, but their permanence could not be depended upon³. If exposed to the air or mounted in Canada balsam dissolved in xylol, the iodine disappears and the crystals lose their polarizing properties. They can be preserved, however, in Canada balsam dissolved in ether.

I have succeeded in making crystals 2-3 mm. in diameter, but they were not flat and far too friable to be ground into parallel plates.

Dr. Herapath's arresting discovery seems to have passed into oblivion until Land succeeded in making a thin sheet of nitrocellulose packed with ultra-microscopic crystals of Herapathite with their optic axes all parallel to one another. Such a sheet behaves like a single extended crystal, with the difference that since the crystalline particles overlap in the direction of the thickness of the film the transmitted beam is absorbed more than it would be in a single crystal and the sheets have a smoky brown appearance.

In his patent specification⁴, Land describes processes by which these sheets may be made. One way is to prepare a gel-like mass containing Herapathite which is thoroughly mixed with a viscous nitrocellulose or cellulose acetate solution. Since the particles are asymmetrical, they will orient themselves in the same direction when the viscous mass is extruded through a slit-like die. But the retarded flow of the outer surfaces of the material during its passage through the die as compared with the flow of deeper layers will give rise to surface shear upsetting the regular arrangement of the crystals. To overcome this difficulty a layer of the charged plastic is placed between two layers of uncharged plastic before extrusion through the die. The middle charged layer then flows with practically uniform velocity over the cross section and the particles are uniformly distributed parallel to one another.

Another method is to place the viscous polarizing

material in contact with a substratum of viscous non-polarizing material, such as fluid celluloid or other colourless oily ester, spread upon a glass plate or sheet of celluloid in such a way as to stretch the polarizing medium. Orientation of the particles may also be brought about by subjecting a diluted colloidal suspension to an electric or magnetic field during the setting of the mass.

It is by some such means described by Land that the Polaroid Corporation of Boston, U.S.A., has succeeded in manufacturing the 'Polaroid' sheets of polarizing material now on the market. Other firms have secured the right to employ the material in special applications. Thus, one firm supplies Polaroid analysers and polarizers for the microscope, as well as for projecting lanterns and other instruments. Another manufactures ophthalmic instruments employing Polaroid. The Eastman Kodak Co. employs the material for photographic purposes under the trade name of 'Pola Screen'; the Royal Photographic Society has awarded the Hood Medal to Mr. Edwin H. Land for his meritorious invention.

There are two grades of Pola screen at present available—Types I and II. Type I consists of sheet material cemented between glass plates of *A* or *B* quality intended for use over the camera lens. The *A* quality glass plates are optical flats hand surfaced of the highest quality, and the *B* plates are of optical glass of good quality which will not affect definition. The plates are mounted in light metal circular rims with an aperture up to $4\frac{1}{2}$ inches. Similar screens with Bakelite rims are also supplied in Great Britain by Polarizers Ltd. Type II is intended for use over light sources and consists of a Polaroid sheet cemented to a single plate of glass. In this form the polarizer slightly diffuses the incident light, but may be had in sheets up to 12 inches square. The amount of polarization by single plates of Polaroid and the transmission of ordinary light through two films parallel and crossed as well as two plates parallel and crossed has been determined by L. R. Ingersoll, J. G. Winans and E. H. Krause⁵ for wave-lengths 4000Å. to 20,000Å. and by J. Strong⁶ for wave-lengths 3000Å. to 11,000Å.

As the behaviour of this new material cannot be judged without some knowledge of such measurements, the following table gives the average figures taken from the curves obtained by these authors. There appears to be some variance with different samples.

The dichroic properties of the material can be plainly seen by the smaller percentage of polarized light in the violet and red ends of the spectrum as compared with the intermediate portions where the absorption of one ray is almost complete. Consequently when a bright light is observed

through two crossed plates, it is seen to be coloured a deep red.

The transparency of films and plates to ordinary light is also not without interest. The material is opaque to the ultra-violet but very transparent to the infra-red, when parallel or crossed; so that a pair of crossed films will serve as an excellent infra-red filter and will not polarize the transmitted radiation. The transparency of films in the visible spectrum is not so great as that of plates, due apparently to greater scatter, but of course the glass in the plates absorbs a large percentage of the infra-red.

	Percentage Polarization	Percentage Transmission			
		Films		Plates	
		Parallel	Crossed	Parallel	Crossed
3000A.	—	0	0	0	0
4000	70	1.5	0	22	5
4500	70	12	0.5	28	4
5000	95	13	0	32	3
5500	98	15	0	33	2.5
6000	98	16	0	33	2.5
6500	96	25	0	33	2.5
7000	91	34	2.5	32	2
8000	32	63	62	28	5
9000	9	77	77	37	29
1 μ	5	85	85	39	43
1.1 μ	—	85	85	41	41
1.5 μ	1	—	—	—	—
2.0 μ	0.5	—	—	—	—

In a subsequent patent specification⁶, Land describes the use and preparation of films of nitrocellulose containing polarizing ultra-microscopic particles of inorganic periodides, particularly purplecobaltchloridesulphateperiodide. He states that films prepared with particles of this substance, suitably oriented, give complete polarization, with a colourless transmitted beam and extremely small loss by absorption. The material should be a great improvement on the Herapathite material.

The scientific and technical applications of Polaroid are almost unlimited. The most obvious and most important application which first springs to the mind and which is specifically mentioned by Land in his first patent specification is to the vexed problem of glare from the headlights of motor vehicles. By covering the aperture of the head lamps with Polaroid with its plane of polarization in a specified position, parallel say to the vertical plane, then an observer looking through a Polaroid screen with its plane of polarization parallel to the horizontal plane will see the head lamp merely as a faint dark red source, but all objects illuminated by the headlight will be seen almost as clearly as without the screen. The light from the head lamp is polarized with its intensity reduced by a little more than fifty per cent, but this polarized light is depolarized into ordinary light when diffusely reflected from the surfaces

of objects, the visibility of which is therefore unimpaired by the observer's crossed screen.

To be effective as an anti-glare device on the road, it would be necessary to enforce the use and the manner of using this material by legislation. But it is not manufactured in Great Britain, and, moreover, the patent rights are in the hands of one body which is very much alive to the immense value of this epochal invention.

Since ordinary light when specularly reflected from non-metallic surfaces at about 32° to 37° to the surface is strongly polarized in the plane of incidence, that is, the vibrations are parallel to the surface, it will be absorbed by transmission through a Polaroid film with its plane of polarization parallel to the surface. Consequently the details of reflecting objects can be seen more clearly through Polaroid films and are invaluable in photographic work. A Pola screen placed in front of the lens of a camera will enable otherwise impossible photographs to be taken obliquely through glass or water. Oblique reflections which hide surface detail or interfere with good composition can be subdued.

A single screen used in the form of spectacles will give the observer all the above advantages and aid his view of glazed pictures obstructed by surface reflections in picture galleries. But such spectacles will not cut out effectively the surface glare of roads from the setting sun which is so troublesome when motoring, since such oblique reflections are scarcely polarized.

If, however, a second screen adjustable by rotation is used in the spectacles a variable anti-glare goggle is at once available, and has been described by E. H. Land in a patent specification⁷. The screens arranged in this way can be used as a practically neutral variable density device of great simplicity and utility in many applications. The light scattered from the blue sky in and about a plane perpendicular to the sun's rays is strongly polarized in the plane containing the sun and the ray from the sky. Consequently the tone of a clear blue sky in a direction perpendicular to the sun's rays can be varied in photography from light to very dark by rotation of a Pola-screen placed in front of the lens, and surrounding objects can be made to stand out in a remarkable manner.

When the illumination is plane polarized by placing a Pola screen type II over the light source, various useful effects can be obtained by observation or photography through a second screen. Though polarized light becomes ordinary light when diffusely reflected, it retains its polarization when specularly reflected from non-metallic surfaces, and troublesome reflections can be cut out by the second screen.

Reflection from metallic surfaces, however, is more complicated. Common light is only partially polarized by metallic reflection, and plane polarized light is reflected as such only when the plane of polarization is in or perpendicular to the plane of incidence. At all other azimuths, plane polarized light is converted into elliptically polarized light by metallic reflection and so the second screen cannot completely cut out such reflections.

The advantage of polarized illumination depends upon the fact that specular reflections can be quenched by the second screen but reflections depolarized by scatter pass through it. When semi-transparent objects are examined or photographed in polarized light, the surface specular reflections can be quenched, but the light diffused from deeper layers passes the second screen and such objects assume a new appearance. Thus the true texture of the skin becomes more apparent, when the illumination is intense.

It has been stated that stereoscopic cinema projection was demonstrated by the inventor of Polaroid in New York a short time ago. For this purpose the two stereoscopic film pictures are projected on to the same screen one over the other, through Polaroid plates with their planes of polarization set at right angles to one another. The audience were supplied with Polaroid spectacles with the plate over the left eye set to cut out the right-eye picture and that over the right eye set to cut out the left-eye picture. But the nature of the projection screen surface has not been disclosed. The usual interference colour effects produced by introducing plates of uniaxial crystals or substances such as Cellophane which behave optically like uniaxial crystals, between two crossed Polaroid screens, might be used for the projection of coloured backgrounds of changing hue on the stage.

The Polaroid screen will also find many scientific uses, more particularly if the somewhat fanciful prices at present demanded are very considerably reduced when mass production starts. It cannot replace the nicol in measuring instruments in which the polarization of the light must be complete, but obviously it can be used with great advantage in photo-elastic apparatus, strain viewers, and projecting lanterns, microscopes, telescopes, ophthalmic instruments in which the nicol restricts the aperture or interferes with the definition of the optical image.

Now that E. H. Land has so successfully demonstrated the possibility of manufacturing polarizing screens, without doubt attention will be concentrated upon the production of more transparent material, transmitting a higher

percentage of plane polarized light uniformly throughout the visible spectrum. It would seem that when the remarkable phenomena of photoanisotropy observed by Weigert and by Zoehner and Coper in recent years are more fully understood, means will be found by which we may completely control the production of plane, circularly or even elliptically polarized light.

Weigert discovered that plane polarized light may turn an isotropic solid colloidal system into an anisotropic one with double refracting and dichroic properties. By exposing a dry layer of silver chloride suspended in gelatine to common light a bluish-red photochloride is formed. If now the photochloride is exposed to intense polarized red light the photochloride becomes double refracting and dichroic, with the plane of polarization parallel to that of the exciting light. Violet or ultra-violet light has no such effect, neither does the photoanisotropy develop at very low temperatures. Werner and Kuhn have found also that photoanisotropy is produced in an aqueous gel of the dye-stuff cotton yellow when excited by plane polarized light.

But Zoehner and Coper have found that circularly polarized light will convert thin photochloride layers prepared by chlorinating silver mirrors into layers exhibiting circular dichroism and circular double refraction. The circular dichroism produced is of the same sign as the dichroism produced by plane polarization. That is to say, the photoanisotropic layer is more transparent to circularly polarized light of the same sense as the exciting red light than to circularly polarized light of the opposite sense.

Circular double refraction in which the circularly polarized wave of one sense is retarded relatively to the wave of the opposite sense of rotation is simply optical activity, and this is the first case in which optical activity has been produced by light itself.

For those who are not fully acquainted with these interesting and important investigations on photoanisotropy it might be mentioned that a brief and lucid description of them has been given by Prof. H. Freundlich², with an extensive bibliography.

¹ *Phil. Mag.*, **3**, 161 (1852); **6**, 346 (1853); **7**, 352 (1854); **9**, 366 (1855).

² "How to Work with the Microscope", by Lionel S. Beale. 5th edn., 1880, p. 23.

³ "The Microscope and its Revelations", by William B. Carpenter. 2nd edn., 1857, pp. 127, 128.

⁴ British Patent No. 412,179. Dec. 16, 1932.

⁵ *J. Opt. Soc. Amer.*, **26**, p. 233 and p. 256 (1936).

⁶ British Patent No. 433,455. Jan. 15, 1934.

⁷ British Patent No. 442,825. June 17, 1935.

⁸ *Photographic J.*, **76**, 395 (1936).

Tree-Ring Chronology in American Prehistory

AN archaeological reconnaissance in 1920 of the Chaco Canyon, New Mexico, on behalf of the National Geographic Society of Washington, D.C., was followed by the decision of that Society to assume responsibility for the exploration of the two prehistoric sites of Pueblo Benito and Pueblo del Arroyo. Of these, the former is the most famous and important of the prehistoric remains of the south-western United States, the ruined structure consisting of a thousand rooms of stone and adobe. Its size alone bears out the evidence of the numerous ruined pueblos immediately adjacent that this now arid area once supported a large and densely concentrated population.

The investigations of the National Geographic Society were under the field direction of Dr. Niel M. Judd. They were carried out by successive annual expeditions in the period 1921-27. In addition to the exploration of the two villages, which were the main objective, observations were made on more than forty other sites in this important archaeological area. The purpose of the expedition was not merely the study of the distinctive culture of Bonitian civilization, but also to determine as closely as possible the conditions which had led to the remarkable concentration of population and efflorescence of culture at this point, and above all, the causes of the decay of this civilization before the advent of the Spaniard to the American continent.

An investigation, which began more or less as a sideline, eventually produced a result of far-reaching importance for American archaeology, of which the end is not yet in sight. This was the application of the tree-ring method of dating to the chronological problem of Pueblo Bonito and other related prehistoric remains of this region.

When the expedition of the National Geographic Society in the Chaco Canyon area came to an end in 1927, it was intended to issue a comprehensive account of the exploration as a whole; but owing to a variety of circumstances this project has had to be abandoned. The results of the expedition and the reports of those who have co-operated in the work, therefore, will appear in a series of independent papers to be known collectively as the Pueblo Bonito Series. Of these, the first, by Dr. A. E. Douglass, on the dating of the ruins by the study of tree-rings shown in the timbers of the buildings, is now available.*

The Pueblo Bonito Expedition first made contact with Dr. Douglass in 1921, when samples of timbers obtained in the first year of the expedition were submitted to him for examination; but it was not until the following year that intensive application of the method was made to the chronological problem at this ruin. Dr. Douglass, when engaged in an attempt to correlate climatic conditions with the periodic recurrence of sunspot activity through the study of tree-ring growth in northern Arizona, had been invited, in 1918, by Dr. Clark Wissler, of the American Museum of Natural History, to attempt a determination by this method of the comparative ages of the ruins of Aztec and Pueblo Bonito. His attention was thus directed to the possibility of dating prehistoric remains by the study of beams of timber surviving in the numerous ruins of the south-west, which presumably had been subject to like climatic conditions, and of constructing from this evidence the beginnings of a time-scale. When the operations at Pueblo Bonito came to an end in 1927, the dating of the ruin had not been determined to his complete satisfaction, and the second beam expedition of 1928—the first expedition took place in 1923—was followed by a third expedition in 1929. By this expedition what had appeared a gap in the evidence was successfully eliminated.

The tree-ring method of dating elaborated by Dr. Douglass is sufficiently well known by now to obviate detailed description. The essential feature is the identification in borings or sections of timber of certain distinctive sequence groups of the ring-growth of the tree due to the influence of an identical annual succession of variation in climatic conditions. Although some thousands of specimens have been examined, no sequence has been found to be exactly duplicated in the course of a period of more than twelve hundred years. By means of the overlap in ring growth in timber at different stages of age at given points in time, it has been possible to build up a time-scale, which proceeds from living trees to historic timbers, namely, beams from buildings of known date, and from historic to prehistoric. Dr. Douglass here figures a complete series of ring growths, which extends from 1929 right back to A.D. 698. The woods which have been found best for the purpose of the investigation are the western yellow pine (*Pinus ponderosa*) and the Douglas fir (*Pseudotsuga taxifolia*), while the next best is the pinyon (*Pinus edulis*).

* National Geographic Society. Contributed Technical Papers, Pueblo Bonito Series, No. 1: Dating Pueblo Bonito and other Ruins of the South-West. By A. E. Douglass. Pp. 74. (Washington, D.C.: National Geographical Society, 1935.)

This elaborated time-scale has been applied to determining the age of a large number of ruins which have furnished the material from which it has been built up; but perhaps of even greater interest for the archæologist than the dating of individual structures is the precision given to the cultural periods, of which the time relation had been determined previously by archæological methods. For example, the beautiful cream-coloured Hopi ware is seen to begin in the early part of the fourteenth century, the polychrome red pottery largely filled the thirteenth, red pottery was common in the twelfth, and black-on-white ware was characteristic of the tenth and eleventh centuries. In more general terms, of the succession of cultural periods into which archæologists have classified Pueblo civilization, Pueblo III, the golden age of south-western prehistory, took its early form in Chaco Canyon about A.D. 919, reached its local climax in the late eleventh century, and probably closed with the great drought which endured from 1276 until 1299. Pueblo IV began in the early thirteenth centuries. Dating, however, is complicated by the problem of centrifugal diffusion. Pueblo culture, it is thought, probably originated at a single centre, from which it spread outwards. It is not, therefore, everywhere contemporaneous.

So far as the dating of individual ruins is concerned, Pueblo Bonito is now shown to be the oldest of the south-western ruins. Its building began in A.D. 919, and the major construction took place in the decade 1060-70, with a lesser activity twenty years later. The important site of Aztec, notwithstanding its size, was built in a

period of twelve years 1110-21. The dates determined for the beginning of construction on forty-five sites range from A.D. 919 until 1417, except for two instances, dated at 1550 and 1770 respectively.

The investigation has thrown light on a number of collateral problems. For example, there is the question of the former existence in this area of considerable pine forests, which have now disappeared, and by their extinction, no doubt, contributed their share to the aridity of the area. Some specimens which have been examined were evidently dead wood at the time they were used, and the confused and almost indistinguishable rings at the end of their growth bear witness to the aridity which caused their death. This formation has been paralleled from trees which have died recently.

The evidence of the grouping of sequences of poor growth is interpreted as pointing to a succession of droughts, which recurred with extreme severity at intervals of about three hundred years. One of these droughts, the most severe, covered the closing years of the thirteenth century (1276-99); another appears from 1573 until 1593; and still another in 1890, with a period of maximum intensity from 1896 until 1904. Periods of drought earlier than these are also perceptible, which go back so far as A.D. 904. The study of these cycles should prove of importance for the future of climatology. Archæologists will look forward with keenest anticipation to the extension of this technique to conditions which will throw light on the beginnings of Pueblo culture and its dating in relation to the culture of the Basket-makers.

Obituary

Mr. R. D. Oldham, F.R.S.

RICHARD DIXON OLDHAM, whose death took place at Llandrindod Wells on July 15, was an original and independent thinker—a little too independent sometimes for those in authority. He was most widely known for his geological work in India and his seismological investigations; but he wrote on other subjects, and his writings are always interesting and suggestive. He was the third son of Dr. Thomas Oldham, F.R.S., the first director of the Geological Survey of India, and was born on July 31, 1858. He was educated at Rugby and the Royal School of Mines, and appears to have been elected to a science scholarship at Emmanuel College, Cambridge, but never took it up. His father, who had retired two years earlier, died in 1878; and he, following his father's footsteps, accepted an appointment on the Indian Geological Survey in 1879.

In the regular fieldwork of the Survey, Oldham had a wide and varied experience, chiefly in the north, ranging from Manipur to Baluchistan; and he also visited the Andaman Islands. The results are to be found in many papers in the "Memoirs" and "Records" of the Survey. In addition to his fieldwork, he edited his father's unpublished papers on earthquakes and thermal springs in India. The most important of these dealt with the Cachar earthquake of 1869, and the editing included the whole of the discussion of the observations collected by his father, a very useful grounding for his later work in seismology. He also compiled a "Bibliography of Indian Geology" (1888), and prepared the second edition of the official "Manual of the Geology of India" (1893). This was essentially a new work, though it incorporated much of the original edition; and several of the new chapters written by Oldham are of great

interest to all geologists, not only to those in India. But perhaps his most important work for the Survey was the "Report on the Great Earthquake of 12th June 1897", forming vol. 29 of the "Memoirs" (1900). Seismology was now his chief interest. He was the first to show (*Phil. Trans.*, A, 194, 135) that the disturbance set up by a great earthquake splits into three distinct forms of wave-motion which, travelling at different rates and along different paths, give rise to the three distinct phases observed in distant seismographic records.

Oldham retired from the Survey in 1903, and for some time lived in the Isle of Wight, where he was near the seismographic station of his great friend, John Milne. His seismological studies were continued; in 1906 he showed that the records of distant earthquakes indicate that the earth has a core very different in properties from the rest, and he determined its diameter approximately. He was indeed a pioneer in the application of seismology to the investigation of the interior of the earth.

In his later years, Oldham spent much time in the south of France, where he studied the history of the Rhône delta, and finally he withdrew to Llandrindod Wells.

Oldham was awarded the Lyell Medal of the Geological Society in 1908, and was president of that Society in 1920-22. He was elected a fellow of the Royal Society in 1911. P. L.

Prof. Snouck Hurgronje

WE regret to record the death of Prof. Christian Snouck Hurgronje of Leyden, the distinguished authority on the religion and customs of Islam, which took place on June 26 at the age of eighty-one years.

Prof. Hurgronje was not only one of the foremost oriental scholars of his time, but he was also a great exponent of the value in affairs of the study of living native institutions, his intimate knowledge of the languages of the East and of the customs, religion and laws of Islam having proved of signal service to the Colonial Government during his residence in the Dutch East Indies.

Hurgronje was born in 1855; and in 1885 was admitted by the University of Leyden to the degree of doctor in Semitic languages and literature for a dissertation on the Feast of Mecca. He continued his oriental studies at Strassburg, and was then appointed instructor in Arabic and the institutions of Islam at the School of Instruction for Dutch-Indian officials at Leyden. In 1884, with the object of obtaining a first-hand knowledge of the religious exercises of Islam, he went to Jiddah, the landing place of pilgrims to Mecca. Here he remained until fully equipped to enter the holy places of Mecca. This he did with pilgrims from the Dutch East Indies in February 1885, and remained in the city until the following August, living with the pilgrims and carrying out their religious observances, until the killing of the French orientalist, Dr. Huber, while trying to penetrate into the interior from Jiddah, led to his expulsion by the Turkish authorities.

In 1889, Hurgronje began his work in the Dutch East Indies, when he was sent out by the Government at The Hague to act as adviser on Moslem institutions in Java. His appointment, originally for two years only, lasted for many years, so valuable did his services prove to the Government. One of his more notable achievements was in tendering advice to the Colonial Government and the Government at The Hague, which was framed in the light of his study of Achinese institutions, and contributed largely to the pacification of northern Sumatra, where the Government had been carrying on a desultory war with the Achinese since 1873.

Although both Cambridge and Leyden had offered chairs to Hurgronje, he declined all such offers until he could regard his work in the East as completed; but he accepted the professorship of Arabic at Leyden in 1906. Here he was not forgetful of his practical experience in the East, and for the remainder of his life he continued to be a close observer of the effect of modern trends in international relations on the development of Islam, a matter upon which he produced several important and authoritative articles. He presided over the Congress of Orientalists when it met at Leyden in 1931, having also been a member of the Congress when it met previously at Leyden in 1883.

Hurgronje was the author of a large number of contributions to the literature of oriental studies. Among his best-known works are "Mekka" (1888), a study of the Achinese (1893-94), and "Une Nouvelle Biographie de Mohammed" (1894).

Dr. F. J. F. Shaw, C.I.E.

DR. F. J. F. Shaw, whose death in India was recently announced, joined the Indian Agricultural Service in 1910 as a mycologist attached to the Agricultural Research Institute, Pusa. He remained at Pusa for the whole of his service except for a short period at Coimbatore in Madras, and was engaged in research in plant pathology and work on the control of plant diseases until 1928, when he was appointed Imperial economic botanist. Even in this latter appointment much of his work was the breeding of crop plants for resistance to disease, so that he retained his interest in plant pathology in the broad sense. Of late, much of his time was occupied in administrative duties, for he was appointed director of the Imperial Institute of Agricultural Research at Pusa in 1934, and as such had the supervision of the arrangements for transferring the Institute, wrecked by the Bihar earthquake that year, to a new site near Delhi. For the last few months he was at Simla officiating as agricultural expert with the Imperial Council of Agricultural Research; but he left to supervise some of the difficult operations of the transfer of the Institute, and was overcome by the heat at Agra.

Dr. Shaw was best known for his researches on the important fungal parasites of Indian crops belonging to the genus *Rhizoctonia*, and for his studies on the diseases of jute and the control of diseases of

fruit trees and pulses. He was little interested in systematic mycology, and was led astray in the identification of the difficult members of the genus *Rhizoctonia* with which he worked, but he effected a considerable advance in knowledge of their biology and morphology. Of recent years, his chief work was a study of the types of the important Indian pulse crop, pigeon pea (*Cajanus indicus*), with the object of breeding for resistance to the wilt disease caused by *Fusarium vasinfectum*; in this difficult problem, for the crop is extensively out-pollinated, he achieved a considerable measure of success. If the work can be carried to a conclusion it will be of great benefit to Indian agriculture, for the disease is extremely destructive and the parasite so completely infests the soil as to necessitate prolonged rotation if the crop is to yield an adequate harvest. Other work on similar lines has been in progress at Pusa under Dr. Shaw's control on a number of crops such as cereals, linseed, gram (*Cicer arietinum*) and other pulses, tobacco and various fibre and oil seed crops; continuity in such work is essential, and Dr. Shaw's untimely death will greatly accentuate the difficulties of carrying it on, already made serious by the aftermath of the earthquake.

Dr. Shaw, who was fifty years of age, was educated at St. Olave's Grammar School and the Royal College of Science, obtaining the A.R.C.S. and D.Sc. (London). He was made a C.I.E. in the King's birthday honours list of this year.

Prof. Kikunaé Ikeda

By the death of Prof. Kikunaé Ikeda on May 3, Japanese science loses one of its foremost students of chemistry. Some details concerning his life and work appear in the May issue of the *Proceedings of the Imperial Academy, Tokyo*. Prof. Ikeda, who was born on October 8, 1864, studied science at the University of Tokyo and graduated in 1889. During the next seven years, he taught chemistry in the Tokyo Higher Normal School, where, both by his teaching and by the text-books that he published, he greatly assisted the general appreciation in Japan of the new science of physical chemistry.

In 1896, Ikeda was appointed assistant professor of chemistry in the University of Tokyo, in which capacity he came to Europe three years later for further study of physical chemistry. During his stay in Europe, he worked in Ostwald's laboratory, where, in collaboration with Bredig, he published important work on the poisoning of colloidal platinum catalysts. He also worked for a short time at the Davy Faraday Laboratory in London. On his return to Japan in 1901, he was appointed to a full professorship in chemistry, which he held for twenty-two years. During this time he was particularly occupied with the study of chemical kinetics and the theory of solutions. During this period he was appointed chief of the Chemistry Division of the Institute of Physical and Chemical Research, and he served also on the National Research Council of Japan.

On retiring from his professorship in 1923, Prof. Ikeda continued to take an active interest in

chemistry. After a stay of seven years in Germany, he returned to Japan in 1931 and established a private laboratory where he studied various problems concerned with the applications of chemistry. The high esteem in which he was held was shown on his sixtieth birthday, when his friends and former pupils arranged a celebration and raised a large sum of money which, by his wish, was given to the Chemical Society of Japan for the extension of the scientific publications of the Society.

Mr. F. S. Stacey

WE regret to announce the death, on August 11, of Mr. Francis Samuel Stacey, one of the pioneers of radiotelegraphy, at the age of fifty-six years.

Mr. Stacey was a student of Finsbury Technical College, and joined Marconi's Wireless Telegraph Co., Ltd. (then known as The Wireless Telegraph and Signal Co., Ltd.), in July, 1899, at the age of twenty years. After a short period in the Company's works he was employed for some time in experimental work as an assistant to Marchese Marconi, and, in 1900, was engaged in the execution of a contract for the installation of wireless on the whole fleet of Belgian cross-channel steamers. Shortly afterwards he was transferred to Marconi's Wireless Telegraph Company of Canada, where he remained until 1910, engaged in the construction of stations, experimental work, and the operation of the Glace Bay trans-Atlantic wireless station.

Between 1910 and 1912 Mr. Stacey was employed at the Marconi station at Poldhu in Cornwall in connexion with experimental work and development of long-range high-power stations which had their birth at Poldhu. From 1912 until 1914 he was acting chief of the Constructional Section of the Marconi Company, and in 1914 became chief of one of the contract sections which deals with the supply of every kind of commercial wireless telegraph apparatus. Among other things, his department of the Marconi Co. has been concerned with the execution of contracts for nearly all the broadcasting stations in England, and a very large number in Europe, Japan, South Africa, and South America.

Mr. Stacey was married in 1909 to Miss M. McLeod, a Canadian lady, and leaves a widow and two daughters.

WE regret to announce the following deaths:

Prof. Luigi Devoto, professor of industrial diseases and director of the clinic of industrial diseases in the University of Milan, on July 22, aged seventy-two years.

Prof. Aubrey C. Grubb, professor of physical chemistry in the University of Saskatchewan, known for his work on the electrical activation of hydrogen and nitrogen gases, on July 29, aged fifty-two years.

Dr. H. A. D. Jowett, manager of the Wellcome Chemical Works, Dartford, an authority on medicinal alkaloids, on August 10, aged sixty-six years.

News and Views

Jean-Baptiste-Louis Romé de l'Isle (1736-90)

AUGUST 26 is the bicentenary of the birth of Jean-Baptiste-Louis Romé de l'Isle, an assiduous student of natural history and a writer on crystallography. He was born at Gray in Haute-Saône. After being educated in Paris, he sailed to the East Indies as secretary of a company of artillery, and in 1761 became a prisoner of the English at Pondicherry, being held captive for three years. Having acquired a taste for science, on his return home he became a student of the chemist Balthasar-George Sage (1740-1824) and applied himself to mineralogy, forming a mineralogical cabinet, and in 1772 publishing his "Essai de Cristallographie". This work he afterwards enlarged and published in 1783 under the title "Cristallographie, ou Description des formes propres à tous les corps du règne minéral dans l'état de combinaison saline pierreuse ou métallique". It contained tables of all the crystals then known. Another subject to which he devoted much time was metrology, stimulated no doubt by the chaotic state of the weights and measures in France at the time. He collected a great mass of material relating to the subject, some of which he embodied in his "Métrologie, ou Table pour servir à l'intelligence des poids et mesures des anciens . . ." which appeared in 1789, the year the Revolution broke out. Through his close application to study he suffered somewhat from failing eyesight, and this being brought to the notice of Louis XVI, he was granted a small pension, although he had held no official position. His death took place in Paris on March 7, 1790.

Water Resources and Supply Control

THE Parliamentary Joint Committee appointed to consider and report on measures for the better conservation and organization of water resources and supplies in England and Wales has, in its report just issued (London: H.M. Stationery Office. 3*d.* net), made some caustic comments on the attitude of the Ministry of Health towards the general aspect of the whole question of national water administration, pointing out the one-sided nature of the composition of the Advisory Committee on Water, upon the reports of which the proposals of the Ministry of Health have been framed. The Joint Committee states that it is of opinion "that the methods of the Ministry of Health justify in no small degree the criticisms that have been levelled against them by reason of their apparent failure either to consider the point of view of, or to consult with, opposing interests before submitting their proposals to the Committee". Accordingly, the Committee does not see its way to endorse the memorandum submitted by the Ministry of Health, in which it is proposed that power should be given to the Minister to make orders scheduling areas within which the conservation of surface or underground water resources for water supplies is of

public interest, the object of the orders being to prevent water from being drawn from those areas for water undertakings, or for industrial or other purposes, without his consent. The evidence of witnesses who appeared before the Committee showed unmistakably the hostility of interests connected with industry, agriculture and fisheries to any such form of dictatorship in water administration, alleging the incompetence of the Ministry of Health to appreciate needs other than those which are associated with water for domestic and sanitary uses. The Committee's judgment is that all proposals for the appropriation of supply areas should remain, as heretofore, under direct parliamentary control, and it is unable to recommend any procedure other than the continuance of that by Private Bill.

Proposed Central Advisory Water Board

THE principal constructive feature of the Joint Committee's report is its recommendation that a statutory Central Advisory Water Board should be set up, comprising representatives of the various ministries affected and other interested bodies, such as catchment and fishery boards, water undertakers and mill and riparian owners. In addition, it recommends the extension and development of the nine Regional Advisory Committees, at present in existence in various parts of the country, by the addition of three or four others, so as to cover the remaining areas, and it expresses the view that these bodies, which are purely voluntary with representation confined to water undertakers and the Ministry of Health, should be enlarged to include representatives of the catchment boards and other interests, and that they should discuss and report to the Central Advisory Water Board on any difficulties or differences and on general matters concerning their respective areas. The Central Board would collect and marshal all the available statistical data and information of the country's water resources and requirements, and advise the appropriate Minister as to the initiation of any schemes or proposals considered necessary in the public interest. The Central Board should further submit reports to all Select Committees of Parliament considering Bills on water supply, and make an annual report to be laid before both Houses of Parliament. The Joint Committee's report also deals with the question of compensation water, admittedly beset with complications, some of which are pointed out. Rejecting the formula proposed by the Ministry of Health, and indeed any formula, since no suitable formula can be found for general application, the Joint Committee concludes its report with a statement of the considerations which must apply in the assessment of compensation water, each case being, of necessity, determined on its particular merits.

Native Medical Practitioners in the South Seas

THE Government of Fiji recognized many years ago the need for a medical service for the native population, but realized that the employment of European doctors on a large scale was impracticable on account of cost, and that practitioners of their own race would be best suited to attend to the needs of the natives. The Government therefore established the Native School of Medicine at Suva for the benefit of Fijians, and for many years its 'graduates' did excellent work. A few years ago, the Rockefeller Foundation commenced investigations upon the problems of disease and of depopulation in these islands, and was so impressed with the success of this Native School that it offered to co-operate with the Fijian Government, and suggested the training of natives from eight groups of islands in the School at Suva. The Government agreed to work in conjunction with the Foundation, and the School was then re-organized and reconstituted in its present form. The School is residential, and is attached to the Suva Memorial Hospital. Its direction is in European hands, the students are under reasonable discipline, and the cost of maintenance is small—something less than £3,000 a year—which is contributed in various ways.

SIR JAMES BARRETT, Vice-Chancellor of the University of Melbourne, gives an account of the activities of the School in an article in the *Morning Post* of August 7. The students are mostly Polynesians, and must pass a matriculation examination before admission, based upon the New Zealand proficiency examination, which ensures a good knowledge of English. The first year of the present four-years' course is devoted to elementary basic science, and the remaining three years provide the student with a sound, practical medical training in the Suva Hospital. After graduation, the practitioners return to their own islands as health or medical officers among their own people. The initial salary of a graduate is £60 a year, rising to a maximum of £150, which suffices for local requirements. If no European doctor is available, as is often the case, the native practitioner may attend to the medical requirements of Europeans. At present, eighty-four practitioners are at work, distributed over Fiji, Samoa, Tonga, the Cook Islands, Gilbert and Ellice Islands, Solomon Islands, and New Hebrides; of these, Fiji takes fifty-six. In addition, native nurses have been trained in large numbers; the Suva Hospital is staffed by twenty European and twenty Fijian nurses, and there are forty-seven obstetric nurses in Fiji alone. Sir James Barrett endorses the very favourable opinion on the efficiency of the School and of the practitioners it has trained expressed by Profs. Wright and Buckmaster, who, having visited Australia and New Zealand on behalf of the Royal College of Surgeons of England, passed through Suva on their return journey. Sir James envisages the adoption of some such system to meet the medical needs of the natives in other parts of the British Empire, referring to the existence of somewhat similar schools already founded in West Africa and Uganda.

The Radcliffe Observatory in South Africa

THE 'turn-over' article in *The Times* of August 7 by Mr. H. E. Wood, the Union Astronomer, deals with astronomy in South Africa in general, and refers in particular to the forthcoming re-establishment of the Radcliffe Observatory at Pretoria. The history of astronomy in South Africa begins in 1685, when Father Tachard called at the Cape on his way to Siam and determined the longitude by observations of Jupiter's satellites. During the next century, two expeditions visited the Cape, and 1820 saw the foundation of the Royal Observatory, which has made such notable contributions to our knowledge of the southern stars. In 1834 Sir John Herschel landed there and made his famous catalogues of nebulae and double stars. There are now four other observatories in South Africa: the Union Observatory and the southern station of Yale University Observatory at Johannesburg, and those of Harvard and Michigan at Bloemfontein. The Radcliffe Observatory, for more than a hundred and sixty years at Oxford, will, it is hoped, have started its new life at Pretoria within the next two years. Good progress is being made with the construction of its 74-inch reflector by Sir Howard Grubb, Parsons and Co. This will differ in several respects from its sister telescope at Toronto, as it will have, in addition to facilities for observation at the Newtonian and Cassegrain focuses, an arrangement for sending the beam of light down the polar axis to a fixed spectrograph, and it will be driven by a synchronous motor, the frequency of the alternating current being controlled by a tuning fork. The disk of Pyrex glass for the large mirror has been cast by the Corning Glass Co. and is now being annealed. The five secondary mirrors will be of fused silica, and the disks for these are being made by the Thermal Syndicate, Ltd.

Archæological Excavations in Britain

WITH the coming of university and school vacations, numbers of voluntary workers are released for archæological investigations in the field. Since July, excavations have been resumed or initiated on many sites in Britain. The scheme of training in field work through voluntary assistance organized by Dr. R. E. Mortimer and the late Mrs. Wheeler is again in being, this year on an extended scale. Nearly a hundred students drawn from universities in the British Isles, Australia, India, Canada, the United States and China are at work on the continued excavation of Maiden Castle, near Dorchester, under the direction of Dr. Wheeler and Col. C. D. Drew. Although the season has only just opened, some important results already have emerged. On the hill-top in the neighbourhood of the temple of the Roman period discovered in 1934, according to a report in *The Times* of August 14, further stone age habitations, with stone implements and pottery, have been discovered. A series of pits has been uncovered, in which were pottery and animal bones, including those of large oxen of a type now extinct. The neolithic site underlying the fortifications is also being explored. Extensive areas containing stone implements and pottery

have been opened up; and a stone age trench now being examined is found to be covered with a well-marked line of turf underlying the later prehistoric rampart. It contains large masses of material of the stone and early bronze ages, while on top of the trench numerous sherds of elaborately decorated Early Bronze Age pottery are being identified.

EXCAVATIONS have also been resumed on behalf of the Ipswich Museum under the direction of the curator, Mr. Guy Maynard, on the Stanton Chair Farm Roman site between Ixworth and Stanton in Suffolk, where investigations were initiated last autumn as a result of the observation of Roman potsherds and tile fragments in a field. Although it is known that the area of the site is at least two hundred feet across, operations at present are confined to a narrow strip, as the ground is under crops. Work, accordingly, has been concentrated on clearing the remains of a bath-house, of which the hypocaust pillars are well preserved, and a drain from the cement floor of an adjacent room still remains. Two levels of flooring and coins of Marcus Aurelius (A.D. 161-186) and Eugenius (A.D. 393) suggest a prolonged, but interrupted occupation. Six weeks of excavation at Castle Dore, an Iron Age hill-fort, near Fowey, in Cornwall, under the direction of Mr. Raleigh Radford, with the unemployed for labour, has confirmed previous conclusions as to its character. It was evidently a strong point commanding the ancient prehistoric road and trade route across the peninsula. It is now considered beyond reasonable doubt that this was, as has been suggested, the palace of the King Mark of Arthurian legend. Students of the University of Liverpool excavating, also with the assistance of local unemployed, on Eddisbury Hill, Cheshire, have brought to light traces of an ancient fortress in the form of walls of local sandstone, five to six feet in height, in an excellent state of preservation.

Ultra-short Wave Radio Communication

THE practical application of ultra-short waves to radio communication made a step forward on June 11, when R.C.A. Communications Inc. gave a public demonstration of their new circuit connecting New York with Philadelphia. A brief illustrated description of this demonstration is given in the June issue of *Communication and Broadcast Engineering* (U.S.A.). The circuit operates over a distance of about 91 miles with the aid of two automatic relay stations situated between the terminal stations at New York and Philadelphia, the longest individual link being 36 miles. A two-way service is provided, and the six wave-lengths required are in the neighbourhood of three metres; the stations are equipped for the transmission of drawings, typescript and other visual material in facsimile, with simultaneous operation of typewriter and telegraph channels. The article referred to above includes a schematic diagram of the circuit which is reproduced from one actually transmitted to New York by the facsimile circuit. The transmitters make use of resonant line circuits in

order to secure frequency stability, while the receivers incorporate the new acorn tubes specially produced for ultra-short wave purposes.

An interesting feature of the new installation is the method by which the unattended relay stations may be turned on or off from either of the terminal stations. The receivers at each of the four stations are always alive and available for reception from their corresponding transmitters. When it is desired to make the circuit ready for traffic, New York or Philadelphia sends out a tone modulation on its carrier wave. This tone is accepted by the receiver at the first relay station, and is caused to start up its own transmitter, which then passes the tone modulation on to the second relay station. The operation is repeated here and also at the other terminal station, where the tone is re-transmitted back through the relay stations on the return circuit. Thus when the tone signal is received back at the terminal station from which it originated, it is known that all six transmitters are in operation and the radio circuit is ready to pass traffic. When the circuit is no longer required, the tone is removed and the transmitters are automatically switched off, one by one, in the same sequence.

League of Nations Reform

In a pamphlet entitled "Anarchy or Peace", Lord Davies discusses the dangers of the present situation in Europe and the possibilities of avoiding the outbreak of an even more disastrous European war (London: The New Commonwealth. 9d.). Referring to the defects of the League of Nations as demonstrated by recent events, Lord Davies asserts that these were due to the absence of an equity tribunal and international police force, and more particularly to the lack of cohesion and determination on the part of States members of the League. Accordingly, he heavily discounts a good many of the proposals to reform the League as designed rather to deprive the League of the very functions which would enable it to secure the peace of the world if its machinery were honestly and whole-heartedly used. Proposals to substitute a series of regional pacts are only too certain to plunge us back in the pre-War system with its inevitable outcome. Lord Davies argues that the only solution of our present dangerous situation lies first in the creation of peaceful procedure for the settlement of all disputes and the revision of treaties. For this purpose, in default of a more satisfactory solution, an equity tribunal holds the field. Secondly, an international police force is required, and he urges once more the equipment of a European air police force under the control and direction of a neutral authority, a reconstituted League. This force must be superior in numbers and equipment to the national air force of any European State which refuses to join in the guarantee. Only a scheme on these lines will suffice to restore the confidence of the smaller powers in the integrity and good faith of the great powers, and endow the League with the superiority of force essential for the establishment of the rule of law.

Liverpool Learned Societies

THE newly issued handbook of the Associated Learned Societies of Liverpool and District shows there are about four thousand members of the twenty-four scientific, industrial, literary, art and educational societies in the association. One of the largest of the industrial societies, the Liverpool Engineering Society, has some seven hundred members, and the Liverpool Naturalists' Field Club is the largest of the Nature and outdoor societies. Since the last handbook was issued ten years ago, the number of learned societies in the association has fallen by two. Local societies which have increased their membership in the past ten years are the British Association of Chemists, the Institute of Chemistry and the Liverpool Naturalists' Field Club; those that have remained at the same strength include the local branch of the Pharmaceutical Society and the Amateur Photographic Association, while those that have declined in membership somewhat include the Liverpool Botanical Society, Geological Society, Biological Society, Literary and Philosophical Society, Astronomical Society, Engineering Society, Lancashire and Cheshire Entomological Society, Society of Chemical Industry and the New Education Fellowship. The Associated Learned Societies of Liverpool and District was formed in 1922, though since 1880 there had been a scheme of co-operation between local societies, chiefly for staging annual exhibitions and soirées of their activities. The work of the present association includes holiday prize contests in the local schools, outdoor and indoor joint meetings of an educational nature, periodical public scientific exhibitions, lectures, etc., and various schemes for closer co-operation amongst the various learned societies of the district.

Research and the Jute Industry

THE prosperity of Bengal, both agricultural and industrial, is dependent very largely on jute, and the intense period of depression which has overtaken the industry since 1929 has caused widespread distress. The Agricultural Commission, of which the present Viceroy was chairman, in a strongly worded paragraph of its report, directed attention to the necessity for the application of scientific methods in the industry; the position has since been surveyed by Dr. S. G. Barker. In the March issue of *Science and Culture*, Dr. Barker's report is discussed. Dr. Barker has recommended a comprehensive scheme of research which includes the establishment of a laboratory with arrangements for the collection of general and technical information and for foreign representation. This new organization is estimated to cost £27,000 per annum, and it would be under the control of the Jute Mills Association. *Science and Culture* appears to doubt whether the control suggested by Dr. Barker is likely to prove successful, since it is feared that the mill owners may be prone to look for immediate financial returns. It is suggested that a scheme organized on the lines of the Indian Central Cotton Committee might be more advantageous. In view of the urgency of the problem, we regard the

nature of the controlling body to be of minor importance, since the success of the scheme will depend mainly upon the director of research and upon the personnel of the new laboratory. It is gratifying, therefore, to learn that the Government of India has already accepted Dr. Barker's proposals, and that it has appointed an Indian Central Jute Committee. The Committee will be financed by Government, which will place at its disposal approximately £30,000 per annum for a minimum period of five years. We extend a cordial welcome to this new research organization, which we have no doubt will do much to restore the ancient prosperity of Bengal.

Road Transport Vehicles

INSTRUCTIVE figures are given in *World Power* of June showing the relative progress made by the three principal types of road transport vehicles—tramways, motor-buses and trolley-buses. In 1930–31, tramways transported 72.7 per cent of all passengers, the motor-bus 24.2 per cent and the trolley-bus 3.1 per cent. In 1934–35 the figures were 59 per cent, 35 per cent and 6 per cent respectively. Although the tramways with 2,479 million passengers in 1934–35 still convey more persons than the motor-bus and trolley-bus combined, the decline of tramway passengers since 1930–31, when it was 3,018 millions, has been continuous. During the year 1935, the number of passengers carried by the trolley-buses was 255 millions, an increase of 36 per cent on the preceding year. The London Passenger Transport Board recently reported an increase of 20 per cent in the London area along trolley-bus routes. It has been calculated that an oil-driven bus would require a 250 horse-power engine to equal the performance of a 100 horse-power trolley-bus with a capacity of 36 seats carrying a full load up a 7 per cent gradient at a speed of 30 miles per hour. From the point of view of national economy, it is a pity, although trolley-bus progress is satisfactory, that it is not making more rapid headway. In the near future, it may be of primary importance to consume home-produced fuel to produce the necessary motive power for traction. When the traffic is very heavy, electric tramways are the most economical, but tram-cars often stop the traffic to unload passengers, whilst trolley-buses can unload them directly on the pavement.

A Horticultural Colour Chart

THE naming of colour is notoriously difficult, and it is unfortunate that the standard works by Ridgway, Oberthur and Dauthenay, and others, are either out of print or too expensive to have wide application. Gardeners are, perhaps, the community most in need of a comprehensive manual portraying accurate shades of colour, and the Royal Horticultural Society is to be congratulated upon its attempt to meet this pressing need. It is proposed to print a volume of a hundred colours, each in four shades, and, if successful, to follow it by a second volume of similar dimensions. The plates would be either loose in a cover, or held by a loose-leaf binder, and the estimated price is 10s.

per volume. This, however, may possibly be reduced if sufficient applications follow the prospectus now issued. A specimen sheet indicates that each colour would be named, and referred also to the British Colour Council's classification, to the "Repertoire des Couleurs", and to the standards of Ridgway and Ostwald. A brief history of the name appears, horticultural examples are cited, and French, German, Italian and Spanish synonyms are given. The chart should have great utility, not only in the garden, but also wherever colours have to be compared with accuracy. A preliminary application form is now available, and those interested should communicate with the Royal Horticultural Society, Vincent Square, S.W.1. It is expected that the first volume will appear towards the end of 1936 or early in 1937.

Medal Awards for Inventions

THE Council of the Institute of Patentees has decided to suspend the award of the Institute Bronze Medal and in place thereof to substitute the Institute's Silver Medal to rank equally with the Founder's Silver Medal. These medals will be awarded in each section of the Exhibition of Inventions to be opened in the Central Hall, Westminster, S.W.1 on September 30 and in Newcastle on November 25; therefore ten silver medals will be awarded throughout the five sub-sections of the New Inventions Section of the Exhibition. The Gold, Silver and Bronze Certificates will be awarded as in previous years. As the Institute proposes to organize a series of exhibitions throughout the country, it has been decided that the Grey-Wilson Memorial Gold Medal, supported by cash prize, together with the Yorkshire Medal, will be competed for during January of each year, the successful exhibitors at any Exhibition organized by the Institute being eligible to compete. The Yorkshire Medal is a new medal which was provided for under the will of the late Mr. Hoffman-Wood, an architect of Addingham, Yorkshire, who died three years ago, and the Institute will make recommendations annually to the trustees regarding its award. The medal is valued at twenty-five guineas, and sufficient funds are available for an award in perpetuity. The award of the Yorkshire Medal must be for an invention not relating to warfare.

International Naval Architecture and Marine Engineering

THE first international meeting of naval architects and marine engineers to be held in the United States takes place in New York on September 14-19, at which papers will be read dealing chiefly with safety of life at sea and large Atlantic liners. The Dominion of Canada, France, Germany, Great Britain, Italy, Japan, Spain and Sweden are sending delegations at the invitation of the Society of Naval Architects and Marine Engineers of New York. The British delegation, under the leadership of Lord Stonehaven, president of the Institution of Naval Architects, and Dr. J. T. Batey, president of the North-East Coast Institution of Engineers and Shipbuilders, will number about a hundred, including ladies, and will represent the Institution of Naval Architects, the

Institute of Marine Engineers, the Institution of Engineers and Shipbuilders in Scotland, and the North-East Coast Institution of Engineers and Shipbuilders.

International Congress of the History of Science

THE fourth International Congress of the History of Science will meet in Prague, in 1937, during the last week of September. The principal theme of the Congress will be "Science in the Eighteenth Century". The chairman of the Congress and of the Organizing Committee is Prof. Quido Vetter, the actual president of the International Academy of the History of Science. The announcement was made and discussed at the meeting of the Academy of the History of Science at Cluj (Rumania) in conjunction with the International Committee of Historians, in April last. During the meeting, several papers of great interest were read: (1) A. Mieli, "Our Present Knowledge of Arabian Science"; (2) Prof. A. Reymond (Lausanne), "Occult Sciences and Exact Science in Ancient Times"; (3) Prof. A. Singh (Lucknow), "History of Trigonometry in India"; and (4) Prof. V. Bologa (Cluj), "Foreign Influences on Rumanian Medicine". In a business session of the meeting, Drs. Reymond, Ulrich, Sergescu, Singh and Greenwood read reports on the organization of the teaching of the history of science in their various countries. The "Chronological Repertory of the Exact Sciences during the Sixteenth Century" was adopted for publication as a special number of the *Bulletin du Comité des Sciences Historiques*.

British School of Archæology at Athens

IN October next the British School of Archæology at Athens will celebrate the fiftieth anniversary of its foundation. As part of the celebration an exhibition will be held at the Royal Academy of Arts, Burlington House, London, to illustrate the discoveries in Greece and Crete, which have resulted from the work of the School. A special section of the exhibition will be devoted to the Minoan civilizations of Greece and the excavations at Knossos, which were conducted by Sir Arthur Evans, honorary student of the School, and in which the architects of the School took part. This section of the exhibition is being prepared by Sir Arthur Evans himself, with the facilities given him by the authorities of the Ashmolean Museum, Oxford, to which the antiquities brought from Knossos by Sir Arthur were entrusted. It is understood that the exhibition will be inaugurated by H.R.H. the Duke of Kent on October 13, at 3 p.m., and will be open to the public from October 14 until November 14. The occasion of the jubilee of the School will also be marked by a special fund which it is proposed to raise to enable the School to increase its staff, improve its library and accommodation, and provide for the needs of the graduates who are sent to Greece in increasing numbers for advanced study by the universities.

Congrès Préhistorique de France

IT is announced that the twelfth session of the Congrès Préhistorique de France will be held at

Toulouse on September 13-16 and continued at Foix on September 17-20. This is the third occasion only on which the Congress has met since the Great War, the meetings, held biennially between 1905 and 1913, having been intermitted during and after the War until 1931. The coming session, which is the first to be held in the Pyrenean region, will afford members an opportunity to visit a number of famous and important archaeological sites, such as Aurignac, Mas d'Azil, Marsoulas, Gargas, Niaux and Portel. Excursions to these are being arranged as part of the daily programme. As is usual in congresses of this character, a number of topics is suggested for the communications to be submitted. These include the earlier palæolithic of the area, the terraces of the Garonne and their quartzites, prehistoric art, the mesolithic and the neolithic periods, and artificial caves and subterranean refuges. Arrangements are being made by the local committees at Toulouse and Foix for a special exhibition of prehistoric finds from the excavations and collections of the archaeologists of the two departments of Haute Garonne and Ariège. It is also to be noted that the Musée d'Histoire Naturelle de Toulouse has a collection of cave exhibits which is considered to be the finest in the whole of France. The Congress, of which M. le Comte H. Begouen will act as president, has the official support of the University of Toulouse, the municipal authorities of Toulouse and Foix, and the Departmental Councils of Haute Garonne and Ariège. Subscriptions (members, 30 francs; members receiving the report, 100 francs; associates, 20 francs) should be forwarded to the General Secretary and Treasurer, M. Ch. Schleicher, 9 rue de Verneuil, Paris (vii^e).

Announcements

AMONG the appointments and promotions in the Colonial Service recently announced are the following: C. C. Webster to be agricultural officer, Nigeria; D. A. B. Davies to be field geologist, British Guiana; H. A. Smith to be divisional engineer, Posts and Telegraphs Department, Nigeria; A. A. Strachan to be senior engineer, Posts and Telegraphs Department, Malaya.

ON August 14, M. Georges Détré, a French airman, established a new world altitude record of 14,836 metres (48,674 ft.) at Villacoublay. According to the Paris correspondent of *The Times*, this figure exceeds by more than 400 metres (1,749 ft.) the previous record set up by the Italian, Signor Donati, in April 1934. The machine used by M. Détré was a Potez 50 Special fitted with a Gnôme-et-Rhône K.14 engine.

The Council of the Iron and Steel Institute makes annually a limited number of grants from the research fund founded by the late Mr. Andrew Carnegie in aid of metallurgical research work. The object of the scheme is to enable qualified students to conduct researches on problems of practical and scientific importance relating to the metallurgy of

iron and steel and allied subjects. Candidates, who must be less than thirty-five years of age, must apply before September 30, on a special form to be obtained from the Secretary of the Institute. The maximum amount granted in any one year will, as a rule, not exceed £100.

OF 2,590 offenders examined in the psychiatric clinic of the Court of General Sessions, New York, within the past year, less than 1 per cent were found to be definitely insane.

DR. MAXIMILIAN EHRENSTEIN, research fellow in physiology, Department of Medicine, University of Virginia, has been awarded one of the prizes of the Van't Hoff Fund by the Royal Academy of Sciences of Amsterdam in recognition of his work on the alkaloids of tobacco and the catalytic dehydrogenation of cyclic bases.

WE have received from the City Librarian of Leeds eight bulletins or catalogues of technical engineering books. They are divided into the following eight groups: (1) mechanics and materials; (2) mechanical engineering; (3) workshop practice; (4) civil engineering; (5) mining engineering; (6) metallurgy and metal working; (7) electrical engineering—part I; (8) electrical engineering—part II. Each of the catalogues is subdivided, so it is a very simple matter to find out the standard technological works dealing with a particular subject. The address is Leeds Public Libraries, Municipal Buildings.

IN the letter "Anomalies in the Fine Structure of the First Spark Spectrum of Iodine" (*NATURE*, June 20, p. 1030), the line λ 4060.2 is said to consist of three components: 0.000 (4), +0.081 (3), +0.121 (2) cm.⁻¹. Dr. K. Murakawa informs us a mistake occurred in his manuscript; this line should read: 0.000 (2), +0.081 (3), +0.121 (4) cm.⁻¹.

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

Temporary assistant civil engineers in the Air Ministry—The Secretary (W.B.9), Room 712, Adastral House, Kingsway, W.C.2 (August 22).

A part-time teacher of zoology and/or biology in the Northern Polytechnic, Holloway, N.7—The Clerk (September 4).

An experimental assistant in a War Department establishment at Woolwich—The Superintendent, Signals Experimental Establishment, Woolwich Common, S.E.18 (September 4).

Junior scientific officers in the National Physical Laboratory, Teddington—The Director (September 15).

An instructor in electrical engineering in the Bulawayo Technical School—The Official Secretary, Office of the High Commissioner for Southern Rhodesia, Rhodesia House, 429 Strand, W.C.2 (September 19).

A professor of anatomy in the University of Manitoba—The Dean, Faculty of Medicine.

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. 332.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Variation of Cosmic Ray Intensity with Sidereal Time

HOURLY records of the intensity of the cosmic radiation have been made at Cape Town since February 1933 in accordance with a scheme organized

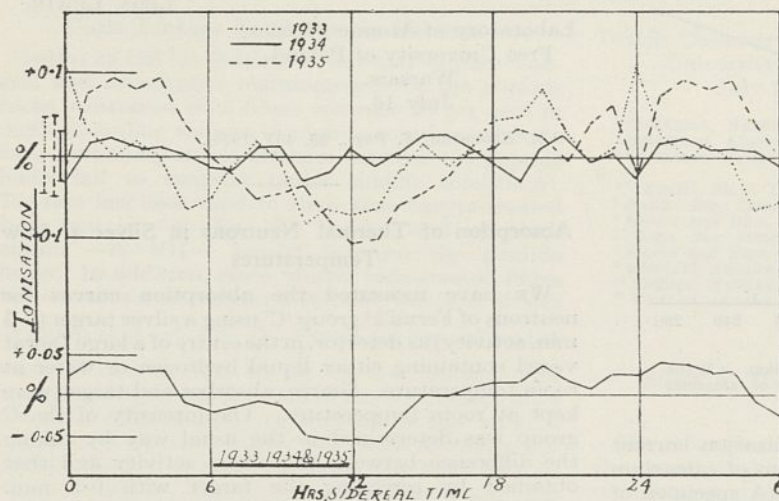


FIG. 1.

by Steinke, Hess and others for the study of the radiation. The instrument consists of an ionization chamber and electrometer provided with photographic registration. The rise of collector potential is compensated every half-minute by a condenser potentiometer device, and the accuracy of a single hourly observation is 0.1 per cent.

We wish to report upon the sidereal time variation during three years of observation, in which for two thirds of each month the chamber was totally enclosed in a shield of lead 10 cm. thick. Each observation has been reduced to a standard pressure of the absorbing atmosphere. Hourly means of intensity have been plotted in the upper set of curves (Fig. 1) for the years 1933, 1934 and 1935, and the combined observations for the three years are shown in the lower curve. The total number of hours of observation is 14,094. Probable errors (root mean square deviations) are indicated by vertical lines on the left-hand side.

It will be seen that the lower curve shows a variation of some 0.04 per cent of the mean, roughly sinusoidal, with maximum at about 24 hr. local sidereal time and minimum at 12 hr. A similar variation is found in the separate curves for 1933 and 1935, but is not definitely indicated in 1934. A variation of this character and phase has been noticed in the observations of Hess and Steinmaurer¹

on the Hafelekar in 1932. Compton and Getting² have ascribed it to the effect of the galactic rotation, which if the rays came uniformly from outer space would cause a maximum to be observed in both hemispheres at 21 hr. local sidereal time. They have pointed out the importance of observations in the southern hemisphere, for if the effect observed in the northern hemisphere were due to a seasonal change in the well-known solar diurnal variation, that in the southern hemisphere should show a maximum at 9 hr., being shifted in phase by 12 hr.

Since no such phase shift is observed, we conclude that the very small variation found in both hemispheres is a true sidereal time effect.

B. F. J. SCHONLAND.
B. DELATIZKY.
J. P. GASKELL.

University,
Cape Town.

¹ V. F. Hess und R. Steinmaurer, *Sitzb. Pr. Akad. der W. (Phys. Math. Klasse)*, **15**, 15 (1933).
² A. H. Compton and V. Getting, *Phys. Rev.*, **47**, 817 (1935).

Measurements of Cosmic Ray Intensity in a Deep Mine

In a coal mine in the neighbourhood of Budapest, at a depth of 315 m. below the surface, we made measurements of the cosmic ray intensity with triple coincidence apparatus. To obtain still thicker layers of material we measured the intensity at different angles from the vertical, using a very narrow aperture. The results of these experiments show that cosmic rays penetrate through a layer with a thickness of 2,500 m. water-equivalent. For corpuscular rays this will mean that the energy of the particles must surpass 10^{12} e.volt, using the formula of Bethe. The intensity distribution was found to be as follows: 1,700 coincidences per hour on the surface, 0.78 coincidences per hour at an effective depth of 700 m. of water and 0.09 coincidences per hour at 2,500 m. effective depth.

We found, further, that cosmic rays may produce showers even after passing through 700 m. water-equivalent, and that the penetrating power of the shower-particles is of the same magnitude as that usually stated for level measurements.

J. BARNÓTHY.
M. FORRÓ.

Institute for Experimental Physics,
University of Budapest,
Budapest. July 22.

Ranges of Particles emitted by Samarium

IN view of some divergences in the determinations of the range of the α -particles of samarium, Prof. Wertenstein suggested that I should make some new experiments on this subject.

The ionization chamber used for determinations of ranges consisted of a spherical glass bulb, of 6.9 cm. radius, with silvered inner walls, and a concentric steel sphere of 1 cm. radius, on which a thin layer of the substance under examination could be deposited. This sphere was connected to a Hoffmann electrometer, while the bulb was put into communication with a vacuum pump. The ionization due to samarium was measured at different pressures. The sensitivity of the electrometer varied within small limits, but was on the average 30,000 ions for a division.

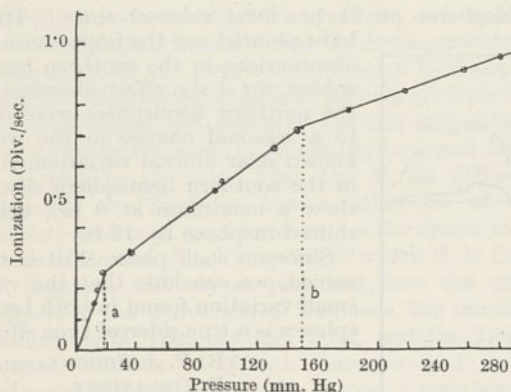


FIG. 1. Ranges of α -particles from samarium. *a* is the new range observed; *b* is the known range of samarium particles.

The curve in Fig. 1 shows the ionization current as a function of the pressure for a film of samarium oxide (Sm_2O_3) of 0.416 mgm./cm.². (A specimen of pure samarium oxide was kindly lent by Prof. G. v. Hevesy to Prof. Wertenstein.) The position of the kink corresponding to the range of α -particles of samarium can be determined with great precision. From this position I find that this range is equal at 760 mm. and 15° to 1.150 cm., in good agreement with the value recently found by R. Hosemann¹.

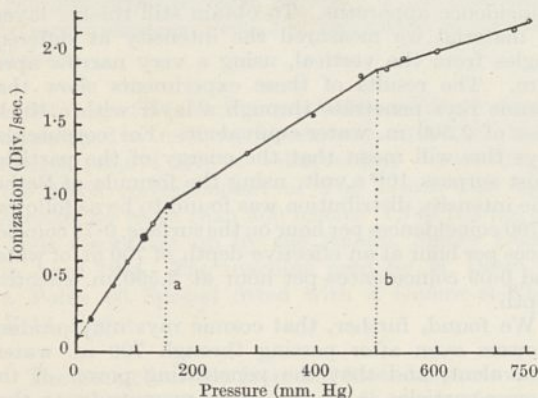


FIG. 2. Ranges of α -particles from samarium and polonium. *a* is the range of particles from samarium; *b* is the known range for particles from polonium.

The curve in Fig. 2 was obtained with a film of 1.05 mgm./cm.² of samarium oxide to which a very small amount of polonium was added for calibration.

The position of the kink due to α -particles of samarium is exactly the same as in Fig. 1, while the range of α -particles of polonium I find to be 3.907 cm., in excellent agreement with recent data.

The interesting fact is that the curve in Fig. 1 shows also another kink, clearly indicating the existence of ionizing particles of much shorter range, namely, 0.13 cm. The existence of these particles is also confirmed by the fact that the straight line continuation of the curve in Fig. 2 does not pass through the origin of co-ordinates but above it.

The total ionization due to these particles is equal to about 35 per cent of the total ionization due to α -particles, which makes it highly improbable that the particles of short range should be recoil atoms of any element formed during the disintegration of samarium. No adequate explanation of the nature and origin of these particles has so far been found, and further experiments are in progress.

LEON LEWIN.

Laboratory of Atomic Physics,
Free University of Poland,
Warsaw.
July 16.

¹ R. Hosemann, *Z. Phys.*, **99**, 405 (1936).

Absorption of Thermal Neutrons in Silver at Low Temperatures

WE have measured the absorption curves for neutrons of Fermi's¹ group 'C' using a silver target (2.3 min. activity) as detector, in the centre of a large Dewar vessel containing either liquid hydrogen or water at room temperature. Source, absorber and target were kept at room temperature. The intensity of the C group was determined in the usual way by taking the difference between the whole activity and that obtained by screening the target with 0.3 mm. cadmium. If a Maxwellian distribution for the energies of neutrons of this group be assumed, and if the $1/v$ absorption law predicted by theory is valid for silver, the ratio of the absorber thickness necessary for equal absorption at different temperatures would be expected to be independent of the absorption itself and to be equal to the square root of the inverse ratio of the temperatures. Experimentally we found that this ratio for 290° K. and 20.4° K. is in fact constant over the whole of the absorption curves; its value, however, was found to be 2.2 ± 0.2 , instead of 3.8 to be expected from the $\sqrt{T_2}/\sqrt{T_1}$ hypothesis. One of the silver absorbers was measured also at 77° K. in paraffin and the ratio of thickness was also in this case considerably smaller than that given by the theory, the point being nearer to 290° K. than to the 20.4° K. curve. The results of the measurements are given in the table below.

Temperature (Kelvin)	Thickness of absorber		Transmission for C-neutrons per cent
	mm.	gm./cm. ²	
20.4°	0.26	0.0273	58.5 ± 3.8
	0.50	0.0525	48.1 ± 2.5
	0.64	0.0672	40.0 ± 2.0
	2.0	0.210	15.3 ± 2.2
	3.0	0.315	9.4 ± 3.6
77°	0.64	0.0672	57.5 ± 2.8
290°	0.64	0.0672	63.8 ± 2.0
	2.0	0.210	31.4 ± 4.4
	3.0	0.315	22.2 ± 1.2

We must conclude, therefore, that at low temperatures either the energy distribution of neutrons in the *C* group is not given by Maxwell's law or the $1/v$ law does not hold for the absorption of *C* neutrons in silver, using the second period as detector.

V. FOMIN.
F. G. HOUTERMANS.
I. W. KURTSCHATOV.
A. I. LEIPUNSKI.
L. SHUBNIKOV.
G. SHTSHEPKIN.

Ukrainian Physico-Technical Institute,
Kharkov.
June 18.

¹ E. Amaldi and E. Fermi, *Ricerc. Scient.*, ser. II, 7, vol. 1, No. 11-12. See also F. Rasetti and G. A. Fink, *Phys. Rev.*, **49**, 642 (1936) and P. N. Powers, G. A. Fink and G. A. Pegram, *Phys. Rev.*, **49**, 650 (1936).

Cross Linkage Formation in Keratins

OWING to the breakdown of salt and sulphur linkages, and consequent rearrangement of the peptide chains, untreated wool fibres contract 30 per cent in length in boiling sodium bisulphite solution, whereas fibres containing stable linkages between the peptide chains fail to contract under similar conditions¹. This fact has been used to show that baryta-treated fibres contain —S—Ba—S— bonds², and set fibres contain —S—NH— bonds³ between the peptide chains. In addition, since caustic soda-treated fibres fail to contract in sodium bisulphite solution, it was suggested that —C—S—C— bonds are formed by the

action of caustic soda on the cystine linkage, thus explaining why skins are more difficult to unhair after treatment with alkali⁴. In support of this view, it was pointed out that Harris had failed to reduce the sulphur content of wool fibres to less than half its original value by caustic soda treatment⁵, and that Küster and Irion had isolated a —C—S—C— derivative from the products of the action of sodium sulphide on wool⁶. More recently, Harris⁷, taking advantage of the work of Zincke and Farr⁸, and of Schöberl⁹, has shown that aldehyde groups are produced by loss of hydrogen sulphide from the sulphenic acid derived from the disulphide bond by alkaline hydrolysis, and Phillips¹⁰ has suggested that the aldehydes may condense with the basic side chains of wool to produce —N=CH— bonds between the peptide chains.

This suggestion appears to be valid, because caustic soda-treated fibres, which fail to contract in boiling sodium bisulphite solution, contract after being subjected to treatments calculated to break —N=CH— bonds. For example, caustic soda-treated fibres, boiled in *N/5* hydrochloric acid for 30 minutes, contracted 16 per cent in boiling 5 per cent sodium bisulphite solution; and treated fibres boiled in *N/10* pyruvic acid for 1 hour contracted 14 per cent under similar conditions¹¹. It seems probable, therefore, that —N=CH— bonds are present in caustic soda-treated fibres, although the incompleteness of the contraction implies that other types of bond are present, possibly the —C—S—C— bond first mentioned in this connexion.

Although Phillips makes no such suggestion in his note¹⁰, it might be assumed that the new linkages formed in 'setting' stretched fibres in steam are

—N=CH— in type, rather than the —S—NH— bonds first postulated. This does not seem to be the case, because fibres set in boiling 2 per cent borax solution fail to contract in boiling *N/5* hydrochloric acid or *N/10* pyruvic acid. Not only so, but the fibres boiled in *N/5* hydrochloric acid retain a set even in boiling sodium bisulphite solution. Similarly, if permanent set were due to the formation of —N=CH— bonds, the response of fibres to setting processes should be increased by pretreatment with alkalis to develop aldehyde groups. In actual fact, setting power decreases steadily with increasing time of treatment with alkali, the amount of permanent set being a linear function of sulphur content in the case of baryta-treated fibres. These and other observations, which will be described elsewhere, find a ready explanation in terms of —S—NH— bond formation in setting processes, but no explanation in terms of the —N=CH— bond.

J. B. SPEAKMAN.

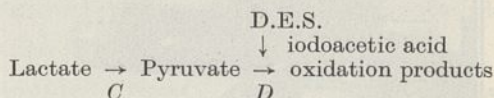
Textile Chemistry Laboratory,
University, Leeds.
July 25.

- ¹ Speakman, *NATURE*, **132**, 930 (1933).
² Speakman, Applied Chemistry Reports, **20**, 164 (1935).
³ Speakman, *J. Soc. Dyers and Colourists*, Jubilee Number, 1934, p. 34.
⁴ Whewell, Ph.D. Thesis, University of Leeds, 1935.
⁵ Harris, *Bur. Stand. J. Research*, **15**, 63 (1935).
⁶ Küster and Irion, *Z. physiol. Chem.*, **184**, 225 (1929).
⁷ Harris, *Bur. Stand. J. Research*, **16**, 475 (1936).
⁸ Zincke and Farr, *Annalen*, **391**, 57 (1912).
⁹ Schöberl, *Annalen*, **507**, 111 (1933).
¹⁰ Phillips, *NATURE*, **133**, 121 (1936).
¹¹ Fischer, *Annalen*, **253**, 63 (1889).

Effect of Dichlor-diethyl-sulphone on Brain Respiration

MY colleagues and I have been developing recently the theory that vitamin B₁ is a specific factor in the oxidation system of pyruvic acid. In a search for substances which would inhibit specifically this action of vitamin B₁ in its relation to the pyruvate oxidase of brain, I tried ten months ago the effect of dichlor-diethyl-sulphone (Cl.CH₂.CH₂)₂.S.O₂, for a specimen of which I am indebted to Dr. E. Walker. I am encouraged to communicate the results by the recent publication of Berenblum, Kendall and Orr¹, who state that D.E.S. with tumour tissue inhibits respiration some 50 per cent and glycolysis some 84 per cent. I have found that the action of D.E.S. upon our brain respiration systems *in vitro* resembles in detail the effect of iodoacetic acid²; the significant points are as follow:

Noticeable effects upon respiration in lactate Ringer phosphate solutions are produced by so little as 0.000087 *M.* (up to 50 per cent inhibition) D.E.S. With 0.000174 *M.* (similar concentration for iodoacetic acid, 0.005 *M.* approx.) and our usual technique, pyruvate is not oxidized, but accumulates from normal respiring brain tissue in presence of lactate. Hence at this concentration in the reactions



there is no appreciable effect upon step *C*, but only upon *D*. Lack of vitamin B₁ also affects stage *D*, but as with iodoacetic acid, the action is not upon the vitamin B₁ component. Addition of excess vitamin B₁ will not restore the action with normal brain

tissues, nor is the toxic effect removed by addition of glutathione (GSH), provided that time has elapsed to permit complete action of the D.E.S., which is rather slow (it needs some 30 min. at 38° C., pH 7.3). Further proof that the vitamin B₁ component is not involved lies in the following: Vitamin B₁ incubated for 35 min. at 38° C. with D.E.S. in excess (pH 7.3) can be proved to be still active by detoxicating the excess D.E.S. present with GSH and testing the solution so formed.

The similarity in action of iodoacetic acid and D.E.S. upon the pyruvate oxidase system is of interest in relation to the similar vesicant action of these compounds, and possibly of interest in tumour research.

RUDOLPH A. PETERS.

Department of Biochemistry,
Oxford,
July 29.

¹ Berenblum, Kendall and Orr, *Biochem J.*, **30**, 709 (1936).

² Peters, Rydin and Thompson, *ibid.*, **29**, 53 (1935).

A Hardness Tester for Microscopical Objects

INCLUSIONS and structural elements of metallographic specimens can be identified by examining the effect of various etching reagents. This method not only takes up a great deal of time, but also demands considerable experience on the part of the examiner.

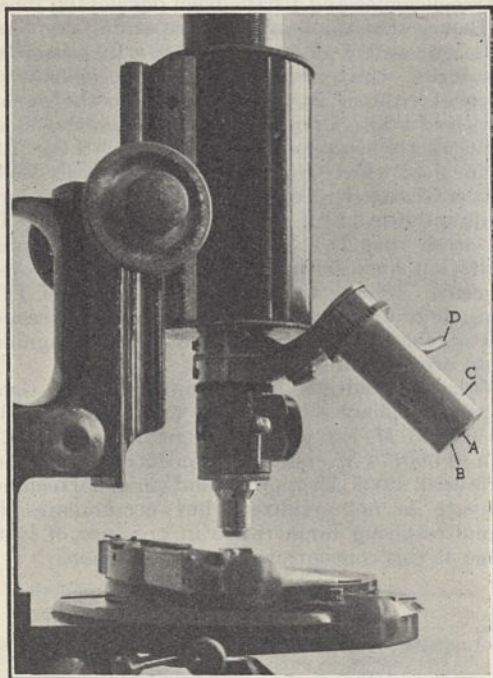


FIG. 1.

A more convenient and objective identification can be obtained by measuring the hardness of the inclusions and structure elements themselves. Instead

of using the scratch hardness tester, which offers considerable difficulties¹, we have designed for this purpose a small and simple instrument, the basic

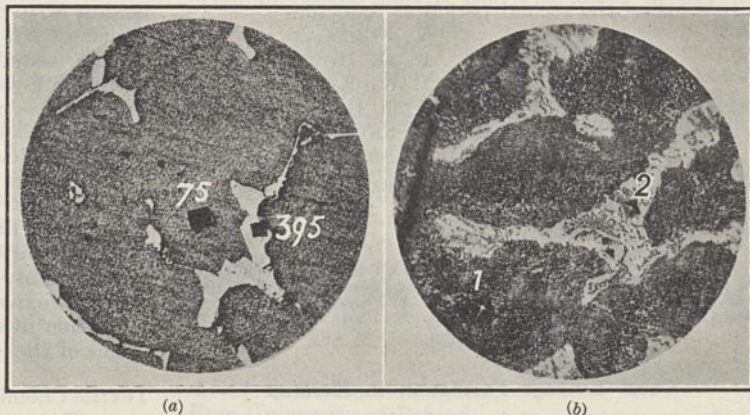


FIG. 2. Micrographs of (a) cast aluminium alloy containing 7.5 per cent copper ($\times 150$); (b) pearlitic cast iron containing 0.8 per cent phosphorus ($\times 300$).

principle of which corresponds exactly with that of the hardness testers of Vickers and of Firth. Fig. 1 shows the instrument mounted in the revolving head of a microscope with a vertical illuminator. The hardness tester consists of a Vickers' diamond *A* with a pyramid-shaped point, which is fixed in a piston *B*. The piston, having a certain weight, can move freely in a cylinder *C*.

The hardness, for example, of an inclusion or of a structural element, is tested in the following manner. The element to be tested is brought into the centre of the field of vision. Then, by turning the revolving head, the hardness tester is brought into the optical axis of the microscope. The tube of the microscope is moved downwards to such an extent that the diamond rests on the specimen and makes a small square impression in the structural element. After a certain time (for example, 30 sec.) the tube of the microscope is again moved upwards and the revolving head turned through 180°. By means of an ocular micrometer, the length of the diagonal of the square is measured, which can be expressed in Vickers numerals in the usual manner.

Fig. 2 (a) is a micrograph of a cast aluminium alloy containing 7.5 per cent of copper. The impressions caused by the diamond are clearly visible. The corresponding hardness numerals have been inserted in the figure.

Fig. 2 (b) is a micrograph of pearlitic cast iron, containing 0.8 per cent of phosphorus. The diamond impressions in the pearlite and the phosphide eutectic are marked 1 and 2 respectively. The corresponding hardnesses are 395 and 775 respectively. The Vickers hardness $V/20$ was 243.

In the case of malleable cast iron, the hardness of the ferrite was 182, that of the pearlite 300. For martensite a hardness of 865 was measured, whilst cementite showed a hardness of 820.

In the examples mentioned above, the load of the diamond is equal to the weight of the piston, namely, 35 grams. It is, however, possible to use arbitrary loads by means of air pressure above the piston. For this purpose an air inlet *D* is fitted to the cylinder *C* (Fig. 1). In this way the instrument

can be applied to normal metallographic microscopes. A further advantage of the apparatus described is that it can be used during ordinary examination of metallographic specimens.

E. M. H. LIPS.
J. SACK.

Natuurkundig Laboratorium
der N. V. Philips' Gloeilampenfabrieken,
Eindhoven.
June 2.

¹ Bierbaum, "The Microcharacter", *Trans. American Society for Steel Treating*, 18, 1009 (1930). Gillet, "Properties of Ferrite as Revealed by Scratch Hardness Tests", *Metals and Alloys*, 5, 159 (1934).

Measurements of Noise

THOSE interested in noise measurement will be aware that a new unit of equivalent loudness, the British Standard Phon, has been introduced by the British Standards Institution (Glossary of Acoustical Terms and Definitions B.S. 661—1936). The standard of reference is a plane sound wave of 1,000 cycles per sec., heard alternately with the noise to be measured by an observer facing the source and listening with both ears. When the reference tone is judged by a 'normal observer' to be as loud as the noise, the equivalent loudness in phons is given by the intensity level of the reference tone above a reference pressure of 0.0002 dyne per sq. cm. The experimental realization of the definition requires the resources of a laboratory, so that it becomes of interest to inquire how far the indications of portable secondary meters used for measurements in the field conform to the standard.

Many subjective secondary meters developed before the formulation of the standard, including one developed by us, operate by the observer listening simultaneously to the noise with one ear and a pure reference tone, presented by a telephone receiver, with the other. The reference tone is then adjusted by trial to loudness equality with the noise, the magnitude of which is expressed as the intensity of the reference tone in decibels above a stated reference intensity. In view of the disparity in listening conditions, it is important to ascertain whether the meter indications conform to the standard. We have carried out measurements, in accordance with the definition, of the equivalent loudness of noises of many types with a group of ten observers, such noises being also measured by the same group using a subjective meter of the type indicated above. It is found that with an instrument adjusted to read correctly for 1,000 cycle high-intensity tones, there are discrepancies of varying amounts up to + 15 db., depending upon the type of noise. For some purposes a correction of - 6 db. to the reading brings the indications sufficiently near to the standard.

A mode of listening approximating more to the definition is made possible by using a meter with two receivers. If suitable sealing is provided, the noise and reference tone may be heard alternately by quickly removing or replacing the receivers on the ears. The reference tone intensity is adjusted by trial until no loudness change is heard on removing or replacing the receivers. Tests with a meter constructed on these lines and calibrated in a 1,000 cycle free field show that for a variety of types of noise from 30 to 95 phons, the true value is given on an average to ± 2.5 phons, the largest discrepancy in mean reading noted being 4 phons.

A meter of this type thus enables the measurement outside the laboratory of any type of steady noise in phons. It has been used for measuring the noise of large engineering plant and has been found more trustworthy than the single-telephone method. The two-telephone meter also forms a link between the plane field distribution of the phon definition and the irregular field distributions which may occur in practice. Such an irregular sound field is thereby assessed in terms of the intensity level of the 1,000 cycle plane wave which, for a 'normal observer', produces an equal loudness sensation. Thus the pronounced directional properties of some microphones, which may have an arbitrary effect in objective noise measurements, may be eliminated.

The performance of secondary meters in terms of the phon will be discussed in a paper which it is hoped to publish in the near future.

B. G. CHURCHER.
A. J. KING.

Research Department,
Metropolitan-Vickers Electrical Co., Ltd.,
Manchester, 17.
July 18.

Influence of Temperature on Crossing-over in *Drosophila*

ALTHOUGH it has now been demonstrated by several workers that crossing-over in certain regions of the chromosomes of *Drosophila melanogaster* is affected by temperature, the experiment reported in Table 8 of Plough's classical paper¹ still remains the only attempt to trace the magnitude of the effect throughout the range of temperature over which *Drosophila* is fertile. Unfortunately, when correcting the data for differences among the controls, a mistake was made which led to the false conclusion that crossing-over showed two maxima, at 13° and at 31° C. The *b-pr-c* region of chromosome II was used for the

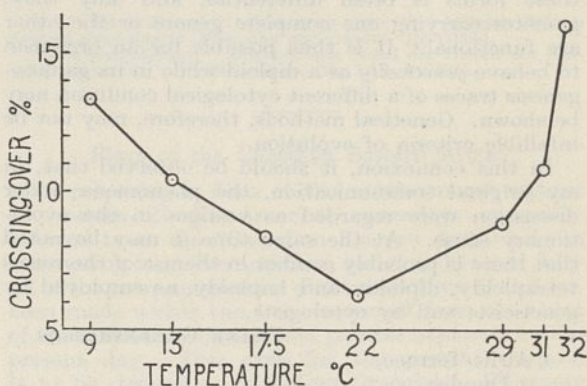


FIG. 1.

experiment. The observed percentages of crossing-over between *b* and *pr* are reproduced in the table below:

Table 1.—Crossing-over between *b* and *pr*. (Data from Plough's Table 8).

Temperature °C.	Observed per cent	Control at 22° C.	Corrected values, that is, 6.0 (Observed)/Control
9	13.5	6.1	13.3
13	13.5	7.8	10.4
17.5	8.3	5.9	8.4
22	6.0	—	6.0
29	8.8	5.9	8.9
31	14.0	7.8	10.8
32	15.7	5.9	16.0

When corrections for the controls are properly applied the relation between crossing-over and temperature is seen to conform to a simple U curve (Fig. 1).

This mistake came to my notice in 1927, but having no first-hand interest I was content to communicate the error to colleagues more specifically interested in genetics of *Drosophila*. It has recently, however, been brought to my notice that the mistake is still a source of trouble. Besides having been reproduced in a number of text-books, the supposed maximum at 13° is of some importance in correlating these data with observations on the effect of temperature both on contraction of muscles (Plough¹) and on chiasma frequency in *Acridiidae* (White²).

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July 22.

¹ H. H. Plough, "The Effect of Temperature on Crossing-over in *Drosophila*", *J. Expt. Zool.*, **24**, 147-209 (1917).

² M. J. D. White, "The Influence of Temperature on Chiasma Frequency", *J. Genetics*, **29**, 203-215 (1934).

Tetraploidy and Hymenoptera

A COMMUNICATION¹ from B. R. Speicher has directed attention to certain genetical data which do not seem to favour my suggestion² that the 'pre-conjugation' phenomena observed in the gametogenesis of the honey bee and of *Cynips kollari* may be interpreted in terms of derived tetraploidy. Now while I admit that the findings of the experiments of Dzierzon, Michailoff and Newell, as quoted in Mr. Speicher's letter, do suggest a simple condition of female diploidy and male haploidy, the facts are by no means fatal to a theory of derived tetraploidy-diploidy based on cytological observations. It has recently been shown that tetraploid hybrids do not necessarily exhibit independent segregation of chromosomes in gametogenesis and also that gametic viability in these forms is often differential, and only those gametes carrying one complete genom or the other are functional. It is thus possible for an organism to behave *genetically* as a diploid while in its gametogenesis traces of a different cytological condition may be shown. Genetical methods, therefore, may not be infallible criteria of evolution.

In this connexion, it should be observed that, in my original communication, the phenomena under discussion were regarded as vestiges in the evolutionary sense. At the same time it may be noted that there is probably conflict in the use of the terms tetraploidy, diploidy and haploidy, as employed by geneticists and by cytologists.

FRANK GREENSHIELDS.

4 Airlie Terrace,
Dundee.
July 28.

¹ B. R. Speicher, *NATURE*, **138**, 78 (1936).

² F. Greenshields, *NATURE*, **137**, 662 (1936).

Refractive Indexes of Ordinary and Heavy Ammonia

MEASUREMENTS of the refractive index of light and heavy ammonia were performed in continuation of former investigations¹. The interferometer and the experimental arrangements were the same as before with the exception that this time one tube was made

of glass and the other of quartz. A discharge tube containing hydrogen, a mercury lamp and a sodium lamp served as sources of light. The spectral lines in question were separated out by means of a monochromator from Winkel-Zeiss.

NH_3 (or ND_3) were produced by adding ordinary water drop by drop (or heavy water, 99 per cent, from Norsk Hydro-Elektrisk Kvalstofaktieselskab) to magnesium nitride. The drying and purification of the gas were performed in a manner similar to that described in the paper dealing with ordinary and heavy hydrogen selenide. The pressure of the gas was between 25 cm. and 28 cm. of mercury, the temperatures between 15° and 20° C. The reduction of the refractive index to the normal conditions and the state of an ideal gas was performed by using the coefficient of dilatation at constant pressure:

$$\alpha_{15, \text{H}} = 0.00366 + 0.000182 \frac{\text{H}}{76}$$

For the quantity ϕ which gives the deviation from Boyle's law the value 0.015 was used from the "International Critical Tables".

The results of the measurements are to be found in the accompanying table.

$(n_0 \div 1) \times 10^6$.

$\lambda \times 10^6 \text{cm.}$	6562.9	5893	5461	4916	4358
NH_3	373.6	375.7	377.7	381.4	386.3
ND_3	369.4	372.6	374.1	378.2	383.3
Δ	4.2	3.1	3.6	3.2	3.0

The refractive indexes of NH_3 are in good agreement with the measurements of C. Cuthbertson², while the measurements of S. Friberg³ and E. W. Cheney⁴ are perceptibly higher.

The method used by the measurements of NH_3 and ND_3 being completely consistent, the differences found between n_{0, NH_3} and n_{0, ND_3} are to be regarded as real in all circumstances.

O. E. FRIVOLD.
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June 9.

¹ O. E. Frivold and O. Hassel, "Brechungsindex u. Molrefraktion des SeH_2 für die D_2 -linie", *Z. phys. Chemie*, **B**, **27**, 316 (1934).

² O. E. Frivold, O. Hassel und T. Skjulstad, "Brechungsindex u. Molrefraktion des Selenwasserstoffs u. des Selendeuterids", *Phys. Z.*, **37**, 134 (1936).

³ Loria, "Lichtbrechung in Gasen".

⁴ *Z. Phys.*, **41**, 378 (1927).

⁵ *Phys. Rev.*, **29**, 292 (1927).

Range of Action of Surface Forces

THE letter by Bowden and Bastow, published in *NATURE*¹ (as well as their communication to the Royal Society²), not only may give, but already has given, rise to the view that the rigidity of thin water films observed by myself has not been confirmed by the above authors³.

A thorough discussion and comparison of Bowden and Bastow's data with mine renders it manifest, however, that there is no contradiction between our respective results. Indeed, it has been shown by my data that the rigidity of water is

exhibited when the thickness of the film is less than 1.5×10^{-5} cm., that is, at a distance less than 0.75×10^{-5} cm. from the glass surface. Rigidity equal to that of lead has been observed in my experiments for distances of $0.5 \times 0.7 \times 10^{-5} = 0.35 \times 10^{-5}$ cm. from the walls.

In accord with the subsequent measurements of Bowden and Bastow, my measurements have, therefore, refuted the indications of the existence of rigid films of liquids of considerably greater thickness to be found in other papers, among them in those by the late Sir William Hardy. The only difference lies in the fact that my measurements have established a smaller and at the same time a more accurate upper limit of the range of surface action for the case of a glass-water interface.

It only follows from Bowden and Bastow's experiments that the range of surface action modifying the mechanical properties of a liquid film does not exceed 2×10^{-5} cm. for a glass surface, the liquid films in their experiments being located between a glass surface and a metal one, that is, one of another kind, and, moreover, a hydrophobic one. More than this, the data given in Table I of their Royal Society paper show that the thickness of the mobile part of the liquid is on the average less by 2×10^{-5} cm. than the optically determined thickness of the gap between the solid surfaces. Although no great weight can be attached to the latter positive result, it shows that there is no question of Bastow and Bowden's data refuting my experiments.

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¹ NATURE, 135, 828 (May 18, 1935).

² Proc. Roy. Soc., A, 151, 220 (1935).

³ NATURE, 135, 834 (1935), "Points from Foregoing Letters".

Effect of Molecular Nitrogen on Molybdenum at High Temperatures

TREATING molybdenum wires of 0.2 mm. in a stationary manner by passing electric current through them and testing the behaviour of the wires under tensile stress, we have found that specimens heated in nitrogen are of quite a different character from those treated in hydrogen, argon or *in vacuo*. The yield point (in general, at the yield point of the wire plastic deformation of the metal commences) and the elongation of the wire in particular are very markedly influenced by nitrogen. Fig. 1 shows the load-extension curves of wires treated in nitrogen, the arrows indicating the yield point of the wire.

The following are the chief points of interest obtained in the course of our experiments. Different pre-treatments of wires exert an appreciable influence on the rate of nitriding. Thus cold-worked wires react much more slowly with nitrogen than they do if they are annealed, whilst the reaction is the slowest of all if the wires are fully recrystallized. In the later case, the characteristic stage represented in Fig. 1, No. 4, cannot be reached at all.

If nitrided wires (Fig. 1, No. 4) are permanently deformed, say, by being bent on little pulleys, they regain fully the original normal properties (Fig. 1, No. 1) which they possessed prior to nitriding. It seems possible that the failure to detect hitherto the effect of nitrogen on molybdenum wires is due to

this peculiar fact. But nitrided wires after being bent revert again to their 'nitrided' stage (Fig. 1, No. 4) if they are flashed even in argon for 1-2 sec.

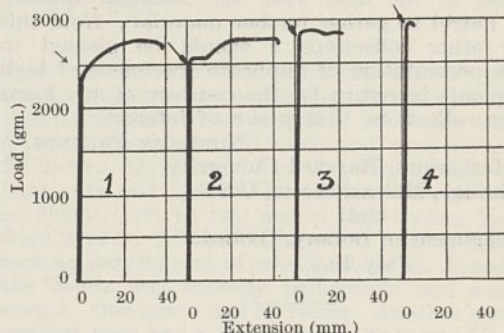


FIG. 1. (1) Wire treated at 1400° C. for 2 min. only in hydrogen. (2), (3) and (4). Wire pre-treated as (1) and then at 1300° C. for 20 sec., 40 sec. and 1 min. respectively in nitrogen.

On nitriding, no changes in the electrical resistivity was observed. The quantity of nitrogen sorbed corresponding to the stage of No. 4 in Fig. 1 is not more than about 0.007 per cent¹. If nitrided wires are heated in hydrogen or *in vacuo*, denitriding takes place. Both contamination of the surface of the wire by carbon and minute traces of oxygen or/and water-vapour present in the gas retard the penetration of nitrogen into the wire.

Our observations appear to be of interest in relation both to the nature of plastic deformation of metals in general and to that of the catalytic action of molybdenum on ammonia synthesis².

We hope to publish fuller data elsewhere at a later date.

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June 22.

¹ C. J. Smithells and C. E. Ransley state that nitrogen diffuses through molybdenum (Proc. Roy. Soc. London, 152 (1935)).

² W. Frankenburger, "Zum heutigen Stand der Theorie der Ammoniak-Katalyse". Z. Elektrochem., No. 1, 2, 5 (1933).

Flora of the Canadian Eastern Arctic

IN preparing a flora of the northernmost regions of eastern North America, nowadays generally referred to as the "Canadian Eastern Arctic", I am attempting to gather together, revise and record fully all of the more substantial plant collections that have been made within the area concerned from the times of the earliest navigators and pioneer explorers to the present day. This area for the present purpose is to be defined as excluding Greenland, Ellesmere (the flora of which is well known) and Boothia Felix, but otherwise as comprising all the mainland of eastern North America that lies east of long. 95° W. and north of lat. 60° N., and all the islands of the arctic archipelago (including the 1,000-miles long Baffin Land) that lie either wholly or in part within these bounds.

Since a number of collections have already come to light in unexpected places, I am taking the liberty of asking you, through the medium of your widely read correspondence columns, kindly to make known my great desire to hear of any further collections

from within this area that I have not already seen in North America or shall not be likely to see in visiting the main European herbaria. I am now returning to the field with the Canadian Eastern Arctic Patrol to gather further material; from this or my other collections I should be pleased to make a presentation of duplicate specimens of high arctic plants in return for the courtesy of any loans of older collections that prove of interest.

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and
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July 10.

The Mysterious Number 137

IN NATURE of July 11, Sir Flinders Petrie points out that Sir Arthur Eddington's cosmical number, 137, is nearly the well-known 'Byrne's' number, 137129, the mantissa of the logarithm of which shows the *same succession of digits*. It is sometimes said to be the number which is equal to its logarithm; but

actually of the number 137·129 . . . we should say that one thousandth of the number is the logarithm, to base 10, of one hundredth of the number. This coincidence between Eddington's and Byrne's numbers can have no physical significance, because the coincidence depends on 10 being used for the scale of notation and the base of the logarithms. The older wisdom of Mars may have adopted scales and bases of twelve; if so, the Martian Eddington would have discovered the number $e5 (11 \times 12 + 5 = 137)$, while the Martian Byrne would have shown that \log (to base twelve) $1.38e66 = 0.138e66$. Raising this number two duodecimal places, we have 138.666 , in the scale of twelve, which equals 188.961 in our notation.

Other such Byrne type numbers can be found in all scales of notation, and they are all different. For example, in the scale and base of three, the Byrne number is 2110220, and 211.022 (in scale of three) only equals 22.296 in our notation.

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July 31.

Points from Foregoing Letters

GRAPHS showing the average hourly intensity of cosmic rays at Cape Town for the years 1933, 1934 and 1935 are submitted by Dr. B. F. J. Schonland, B. Delatizky and J. P. Gaskell. A slight sinusoidal variation is apparent, with a maximum at about 24 hr. local sidereal time and a minimum at 12 hr. The variation appears to be a true sidereal time effect, since it occurs simultaneously in both hemispheres.

Measurements of cosmic ray intensity in a deep coal mine, carried out by Drs. J. Barnóthy and M. Fórró, indicate that some of the rays penetrate through a thickness equivalent to 2,500 m. of water. These would correspond to particles having an energy greater than 10^{12} electron volts.

New measurements by L. Lewin of the range of particles emitted by samarium show, in addition to the alpha-particles of 1.15 cm. range, also the presence of ionizing particles of 0.13 cm. range, amounting to about one third the total ionization due to alpha-particles.

The absorption by silver of 'thermal' neutrons at low temperatures (20.4° and 77° K.) has been determined by a group of investigators from the Ukrainian Physico-Technical Institute. They find that the ratio of the absorber thickness necessary for equal absorption at different temperatures, though constant, has a value of only about two thirds that to be expected if the absorption were inversely proportional to the velocity and a Maxwellian distribution for the energies of the neutrons be assumed.

The nature of the chemical linkages responsible for the contraction of wool when treated by various reagents is discussed by Dr. J. B. Speakman. He considers that the 'permanent set' is to be explained by the formation of $-S-NH-$ bonds rather than in terms of $-N=CH-$ bonds.

Prof. R. A. Peters describes the effect of dichlor-diethyl-sulphone upon the respiration of brain tissue *in vitro*. As in the case of iodoacetic acid, there is

no interference with the change of lactic to pyruvic acid, but the further oxidation of pyruvic acid is inhibited.

An instrument for testing the hardness of microscopic objects is described by Dr. E. M. H. Lips and J. Sack, who submit photomicrographs of copper-aluminium alloy and of cast iron containing phosphorus to illustrate the usefulness of the new apparatus.

Results of noise measurements made with earlier types of meters are compared by B. G. Churcher and A. J. King with values obtained by means of the new standard apparatus. The authors indicate conditions under which approximately equivalent results can be obtained.

H. F. Smith recalculates the percentage 'crossing-over' effect in the chromosomes of the fruit-fly at different temperatures, from the experimental results of Plough, allowing for differences among the controls. He points out that the graph has a U-shaped form with a minimum at 22° C., and that there are no maxima at 13° and 31° as sometimes stated.

The refractive indexes of ordinary and of heavy ammonia gas (ND_3) for various wave-lengths between 4358 and 6562.9×10^{-8} cm. have been determined by O. E. Frivold, Prof. O. Hassel and S. Rustad. The values for the heavy ammonia are slightly lower than those for ordinary ammonia.

Dr. B. Derjaguin directs attention to the fact that there is no disagreement between his findings that films of water of less than 1.5×10^{-5} cm. thickness have great rigidity, and the results of Bowden and Bastow, who have found no change from normal behaviour at thicknesses greater than 2×10^{-5} cm.

Diagrams showing the hardening of molybdenum wires heated in nitrogen at 1300° C. (by passing an electric current) are submitted by P. Túry and S. Krausz. The quantity of nitrogen 'sorbed' by the molybdenum is small (about 0.007 per cent).

Research Items

Tuberculosis and Inheritance

As part of the laboratory work in connexion with a course in human biology in Johns Hopkins University, Baltimore, Prof. Raymond Pearl initiated a study of family history records with reference to families in which tuberculosis had occurred. Analysis and discussion of the data have elicited some interesting results (*Z. Rassenkunde*, 3, 3). The records examined include 3,608 individuals in the classification of parents and children. Taking all the offspring together, 11.3 per cent were tuberculous, which is in reasonable agreement with the known prevalence of tuberculosis in Baltimore at the time the records were taken. The families average between 4 and 4.6 children. Four types of mating were differentiated and the percentage of tuberculous offspring in each type noted. There were: Both parents tuberculous, 35.7 per cent; father tuberculous, 14.0 per cent; mother tuberculous, 13.0 per cent; neither parent tuberculous, 8.3 per cent. The smoothness and regularity of the results are noteworthy. The incidence in the non-tuberculous parentage is a little more than half that of the tuberculous - non-tuberculous mating. The rates of the two latter types are essentially in agreement, as might be expected theoretically, if it is assumed that tuberculosis is neither a sex-linked nor a sex-limited phenomenon. Further, the full tuberculous mating gives an offspring incidence a little more than four times that from the full non-tuberculous mating. The regular increase in the offspring percentage incidence, as the amount of parental tuberculosis increases, seems impossible of rational explanation on any other basis than that of hereditary influence, as the risk of contact infection is not quantitatively doubled. The risk of infection as between the children of tuberculous and non-tuberculous parentage would seem greater than is indicated by the figures. It seems impossible, with the data at present available, to postulate any simple rational Mendelian formula that will accurately describe the results.

Archæology in Western Colombia

IN 1935 Dr. Henry Wassén had the opportunity of examining a number of graves belonging to an ancient Indian settlement on the estate of El Dorado in the western Colombian Cordilleras, midway between Yotoco and Rostrepo in the Department of Valle del Cauca (*Ethnologiska Studien*, 1936, No. 2: Göteborg Museum). Among the objects found in the neighbourhood described, but not found by the author, are two vessels painted in red-brown, of a characteristic shape, the neck rising from a horizontal plane. Three strong handles, adapted for carrying the vessel on the back, are at different levels. This arrangement does not appear to have been recorded previously among archæological finds in South America, but can be paralleled from Mexico. Further examples were obtained from the graves. Nine graves in all were opened up on four different sites. The type form is a shaft, oblong in section, the long sides orientated north and south, with a recess, or chamber, usually on the north, but here on the south side, elliptical or rectangular in shape. The shaft is

here four to six metres deep, between one and two metres long, and approximating to a metre in breadth. Examples have been recorded in which the shaft is 14-17 metres deep (Cauca) and even so much as 25 metres (Quindío). The elliptical recess, with its long axis east and west, approximates to a metre in height, two to two and a half metres long and from 0.75 to 1.35 m. in breadth. One recess was a rectangular chamber of considerable size. In one group the recess was scarcely perceptible and not deep-seated. One grave had no recess. Another grave of a distinct type had a square shaft, 6.10 m. deep, with the chamber below the level of the bottom of the shaft, the entrance to the recess being closed by a grinding stone. This had evidently contained the body of a woman, as was shown by spindle whorls. A hair ornament in the form of nippers and a part of a nose ornament, as well as the position of the teeth, indicated that the head had been placed to the north. On analysis the nose ornament proved to be composed of gold (64 per cent), silver (9 per cent) and copper (27 per cent). Green stain on the teeth indicated the presence of copper. The skeletons had completely perished, except for a few fragments and some teeth.

The Medusæ *Eirene* and *Helgicirra*

DR. P. L. KRAMP clears up much confusion in his paper "On the Leptomedusæ of the Genera *Eirene* Eschscholtz and *Helgicirra* Hartlaub" (*Vidensk. Medd. fra Dansk naturh. Foren.*, 99; 1936). True cirrhi are absent in *Eirene* but present in *Helgicirra*, and on this character the genera may be divided. Twelve species of *Eirene* are distinguished here, and five or six species of *Helgicirra*, the genotypes being *Eirene viridula* and *Helgicirra schulzei*. A re-examination of material previously identified by the author as *Eirene viridula* shows that specimens from the coast of Belgium and the Straits of Dover (1930) are correctly identified, but the majority of those from the coast of Jutland (1927) belong to *Helgicirra schulzei*, a few being *Eirene viridula*; those from the Straits of Gibraltar and the coast of Tunis (1924) are *Helgicirra schulzei*, and those from the coast of Portugal (1910) are *Helgicirra cari*.

Sponges of the North Sea and Baltic

DR. W. ARNDT in his monograph Porifera (Systematische Teil) in "Die Tierwelt der Nord- und Ostsee", Lief. 27, Teil 3a₁ (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1935) makes a very complete systematic survey of the sponges in these regions. There is a large sponge fauna to be found in the North Sea and Baltic, including representatives of many families. These are all described in detail, with good text figures, whilst useful keys of families, genera and species are given, with instructions for technique for studying living and preserved material, and an excellent bibliography. This most useful work on the fauna of the North Sea and Baltic keeps well up to standard in the present part, which also includes an interesting account of Thalassobionte und thalassophile Diptera Nematocera (Teil 11, e₃) by W. Hennig.

Experimental Neoplasms

THE developing blastoderms of birds and reptiles occasionally exhibit, in the region of the primitive streak, proliferating masses of cells which, while they multiply freely, show no tendency to transform into embryos or embryonic structures. These pathological masses grow with considerable rapidity and exhibit all the characters of neoplasms, and for that reason they have been termed by Tur "neoplasmoides embryonnaires". This author has produced the same type of growth experimentally by means of a thermo-electric cautery (*Bull. Int. Acad. Polonoise*, July 1935). The platinum needle, which becomes white hot, is carried by a mechanism which enables it to be applied accurately to any given point on or near the blastoderm, and also to apply the heat for a definite period. It also allows the heat to be controlled without the loss that would take place in manipulating a heated needle through the albumen layer. After treatment, the aperture in the egg shell is sealed with a cover slip and incubation allowed to proceed. Freshly laid eggs are employed, and the heat applied to the centre of the area pellucida. In this manner, a neoplasm can practically always be produced, and like those occurring naturally they not only exhibit remarkable power of proliferation but also blood elements appear precociously. The author suggests that this phenomenon should be considered in relation to cancer.

Haploids in Cotton

SEA ISLAND cotton produces haploids—known as 'man cotton'—in the proportion of one in three or four thousand plants. This type was described by Dr. S. C. Harland in 1920, but its haploid nature was not recognized until much later. By removing the testas of several thousand seeds of one variety, Harland found (*J. Hered.*, 27, No. 6) that twenty seeds contained two embryos, which yielded in nearly every case one haploid and one diploid seedling. Indian workers have shown that in rice, where a high proportion of haploids also occurs, the same form of polyembryony exists. Such ovules may contain two embryo sacs, or it is possible that the diploid embryo arises from nucellar budding while the haploid develops from a parthenogenetic egg. Many of the cotton haploids are fertile with the pollen of other forms, although some are completely sterile. Harland suggests that if diploids could be produced from the haploids by the decapitation method, the resulting homozygous strains would be of much value in breeding work, especially in cotton, which is a highly heterozygous crop plant.

Control of Downy Mildew of Tobacco

AN interesting method of controlling the fungus disease known as downy mildew, or blue mould, of the tobacco plant, is reported in an account by Science Service from Canberra, Australia. This describes the work of Dr. H. R. Angell, Messrs. J. M. Allan and A. V. Hill, who have shown that early infection can be prevented by raising seedlings in an atmosphere containing vapour of benzol or toluol. Special seed-beds covered with glass have been prepared, and numerous shallow vessels containing the benzol or toluol are placed within. The young seedlings make healthy growth, and when transplanted do not contract the disease. Large-scale field tests are in progress, and their results will be awaited with interest.

The Heat Capacity of Ice

IT has been known for some years that the entropy of ice as given by the integral $\int_0^T C_p d\ln T$ does not agree with the value calculated from the entropy of water vapour as found from its band spectrum, there being a discrepancy of about 1 gm.cal. per degree per mol. W. F. Giauque and J. W. Stout (*J. Amer. Chem. Soc.*, 58, 1144; 1936) have now redetermined the heat capacity of ice from 16.4 to 267.7° abs. The latent heats of fusion and evaporation are accurately known, and the value of the integral is thus found to be 44.28 ± 0.05 gm.cal./1°/mol. at 1 atm. and 298.1° Abs. The spectroscopic value is 45.10, leading to a discrepancy of 0.82. This is in agreement with a discrepancy of 0.806 calculated by Pauling on the assumption of random orientations of hydrogen bonds in ice, and the supposition that when ice is cooled to low temperatures it fails to attain the ordered arrangement which would correspond with zero entropy. It has been found that ice has no measurable heat capacity between 0.2 and 4° Abs., and the authors state that no difference in thermal properties of ice could be detected in samples prepared by slow or rapid cooling.

Manganese Trichloride

ALTHOUGH the existence of a higher chloride of manganese, probably $MnCl_3$, has often been reported, its existence in the pure state has only recently been demonstrated. A. Chrétien and G. Varga (*Bull. Soc. Chim.*, 3, 1263; 1936) have obtained the trichloride as a brown crystalline mass by acting upon manganic acetate, $Mn(C_2H_3O_2)_3$, with liquid hydrogen chloride at -100° . A violent reaction occurs, and an olive-green liquid is produced. This is evaporated to dryness at the same temperature. The solid may be heated to room temperature in a closed vessel with little decomposition. On heating, it evolves chlorine and leaves a white residue of manganous chloride.

Spectra of B-Type Stars

Two papers by E. G. Williams on B-type stars have appeared recently in the *Astrophysical Journal* (83, 279 and 305). The first paper describes the spectrophotometric observations of 84 stars over the range 4922–3820 Å. Intensities (expressed in equivalent widths) were obtained for all measurable lines in this range, and in addition line depths were measured for H and He lines. In the case of H and He lines it was also possible to obtain reliable contours, which were observed to be exponential in form except in diffuse-line stars, where the centres were rather blunt. The results of the first paper have been used in the second in an attack on the problem of classification, which presents well-known difficulties in the case of B-type stars. These difficulties, together with earlier attempts to overcome them, are first reviewed by the author, who decides that line ratios, rather than simple intensities, are preferable as criteria of classification. He suggests seven ratios, some of which involve the combination of line intensities from several different elements. The resulting classification is arranged to agree in the mean with the Henry Draper system, but with added subdivisions and with the numbers of stars in each subdivision progressing smoothly with type. Statistical relations between spectral type (as redetermined) and line intensities of various atoms are discussed, and some interesting luminosity effects are also obtained.

New Heating Laboratory at the Building Research Station

By A. F. Dufton

"In the field of heating and ventilation many phases are still beyond the realm of scientific analysis: as far as possible these topics should be studied for the benefits that might accrue. Scientific methods alone can give us the assurance that we are headed in the right direction, particularly in those departures from standard practice occasionally necessary in everyday application."—

RIETSCHEL, 1893.

PRACTITIONERS in the art of heating are dependent to a great extent upon rules-of-thumb, and are finding, in this age of progress, some difficulty in adapting standard practices and calculations to meet modern requirements. The introduction of panel-heating, for example, has not only made necessary a revision of ideas as to what constitutes a comfortably warmed environment but has brought out also the important fact that the received methods of computing the heat losses of a building are only directly applicable when the building is heated in the 'traditional' manner. The introduction of electric-heating, moreover, particularly of schools, has lent an added interest to the effect of the fabric of a room upon the rate of warming and to the general question of the economics of intermittent heating. The Institution of Heating and Ventilating Engineers, fully appreciating the importance of scientific research, expressed the desire to associate itself as closely as possible with any researches on heating and ventilation under the auspices of the Department of Scientific and Industrial Research, and offered to provide funds to enable this work to be accelerated and extended. With this encouragement, it has now been possible to implement a proposal that a room should be erected with walls, ceiling and floor exposed to controlled conditions, in order to facilitate the study not only of different methods of heating, of the problems of intermittent heating and of the influence of ventilation upon heating, but also of those phases of building construction of interest to heating engineers.

It has been considered a matter of first importance that the controlled conditions should be clearly defined and reproducible, and that they should be independent not only of outside weather conditions but also of the condition of the interior of the room. The idea of a test-room within a controlled enclosure is not new, and a certain number of such rooms have been described and built elsewhere. In each case, however, the controlled conditions have been secured by regulating the air-temperature throughout the enveloping space. This is extremely difficult to accomplish satisfactorily and it does not provide, moreover, a clearly defined enclosure, since it permits of variations in the temperatures of the enclosing

walls, to which, of course, the walls of the test-room radiate.

In the heating laboratory which has now been erected at the Building Research Station, Garston (Fig. 1), the temperature of the air in the enclosure is not regulated, and the enclosure is controlled by means of an extensive system of panel-warming and panel-cooling pipes in the walls, floor and ceiling. This enclosure is defined when the temperatures of the various surfaces are specified.

As will be seen from Fig. 2, the heating laboratory comprises the test-room, surrounded by its enclosure, together with an engine-room and an instrument room. The test-room, which measures 18 ft. by

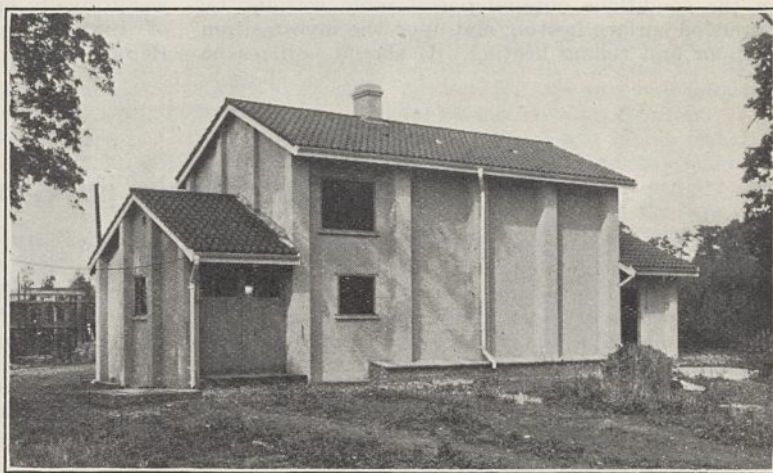


FIG. 1. Heating Laboratory at the Building Research Station, Garston.

12 ft., is built of 9-in. brickwork, plastered internally, and the floor and ceiling are constructed of wooden joists, lathed and plastered below, and boarded above. The height of the ceiling can be adjusted between the limits of 8 ft. 6 in. and 11 ft. 6 in.

The walls of the enclosure are heated or cooled by means of calcium-brine pumped through the embedded pipes which are spaced at 6-in. centres, and their mean surface temperatures are individually controlled to 0.1° F. by copper resistance-thermometers in conjunction with a sensitive relay system. Each wall surface is tested once in every 6 minutes and the controls then automatically raise or lower the temperature of the brine by means of specially designed modulating valves. Each modulating valve is driven by a Warren motor of 10 micro-horse-power.

The modulating valves, which are in the engine room, are fed with hot or cold brine from two insulated storage tanks of 200 and 400 gallons capacity respectively, and the necessary cooling is provided by a 4½-ton ammonia refrigerating plant which is automatic in operation.

Provision is made for the air in the test-room to be changed at rates up to four air changes per hour, with incoming air controlled at 40° F. or other suitable temperature.

In the programme of research which has been under consideration by the Heating and Ventilation Committee of the Department, on which are members of the Institution of Heating and Ventilating

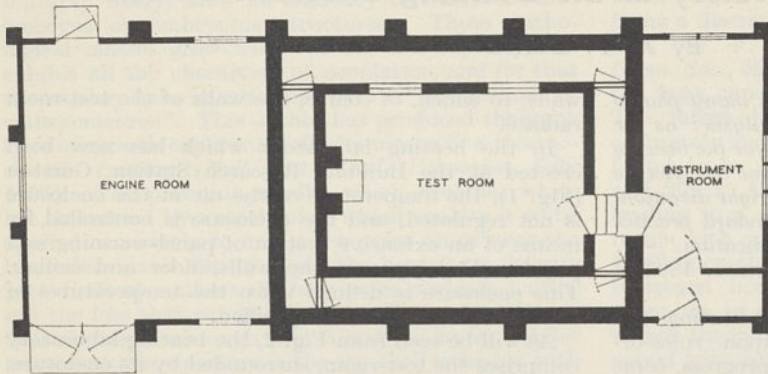


FIG. 2.

Engineers, emphasis has been placed upon the study of the conditions obtaining in a room warmed by extended surface heating and upon the investigation of floor and ceiling heating. It should perhaps be

made clear that the new laboratory is specially designed for comparative work, and in the examination of floor heating, for example, it is clearly important to obtain an adequate comparison with other forms of heating. The most common form of central heating in use at the present time is by cast-iron radiators, and it is proposed, therefore, to adopt this as a standard of reference. This will not only provide a very convenient 'yardstick' but will also ensure that a substantial body of data will be obtained relative to this important type of heating.

The new laboratory was open for inspection on the occasion of the annual visit of the Institution of Heating and Ventilating Engineers on July 22, when the members were received by Sir Raymond Unwin, the chairman of the Building Research Board, and the laboratory was formally opened by Sir Frank Smith, secretary of the Department of Scientific and Industrial Research.

Petroleum Fuels in Canada

DURING recent years, importers and consumers of petroleum fuels in Canada have furnished statistics of deliveries and uses of these products to the Department of Mines. Resulting from correlation of data supplied, a report has been prepared entitled "Petroleum Fuels in Canada" (Department of Mines, Bulletin 772; 1936) from which many interesting facts emerge.

Fuels are divided into four classes: fuel oil, kerosene, gasoline and petroleum coke; after summary tables showing quantities of each marketed in Canada during 1933 and 1934, and amounts distributed in each of the Provinces, the classes are studied separately. In 1934 more than 86 per cent of the total fuel oil was processed in Canadian refineries, the rest being imported; of this, 26 per cent was used for domestic heating, 23 per cent for industrial heating and power, more than 5 per cent for tractor fuel and more than 46 per cent for rail and water transportations. In the same year deliveries of kerosene were less than one eleventh of the volume of fuel oil and represented only one twenty-fifth of the total of petroleum fuels; actually only 36.2 million

gallons were delivered in Canada, which is substantially less than was delivered in 1933; approximately 66 per cent of this was used for domestic heating, cooking and lighting, 24.5 per cent for tractor fuel and the remainder for other general uses.

Gasoline statistics included in the report are not strictly comparable with those of fuel oil and kerosene as they represent totals recorded by provincial tax departments of the Bureau and are interpreted subject to provisos as to amounts sold, etc., effective each year in each province. The gallonages supplied under each purpose use are therefore treated as estimates; nevertheless tables showing gasoline sales by provinces and quantities sold for motoring and other purposes are of interest as indication of destination of gasoline marketed in Canada.

Petroleum coke is used primarily as a fuel for domestic and industrial heating but is also a useful component of electric batteries, carbon lamps, crucibles and other manufactured articles; in 1934 approximately 57,000 short tons were sold for fuel, of which about 39,000 tons were destined for domestic heating and 18,000 for industrial heating.

Problems of Translocation in the Plant

MESSRS. Mason, Maskell and Phillis continue their analysis of the movement of substances in the cotton plant in two papers published in the *Annals of Botany* (50, January 1936).

They first give their reasons for rejecting, on present evidence, either the Münch theory of mass flow in the phloem, or the theory of protoplasmic streaming, as providing a satisfactory mechanism

for the movements that take place. Any view of mechanism must be influenced by definite information as to whether the phloem can function at the same time to deliver different materials in opposite directions, and these two papers describe the results of experiments designed to elucidate this point. The first paper (by Mason, Maskell and Phillis) shows that whilst very slow import of sugar into darkened

leaves is suggested by a formation of starch around the veins of such leaves when they remain in communication with illuminated foliage, yet the behaviour of such darkened leaves isolated by rings as compared with non-isolated leaves does not permit a safe conclusion that sugar may still move in whilst nitrogen moves out. Experiments with defoliated plants with tops in a humid atmosphere suggest that even when transpiration is so reduced, the nitrogen supply of the tops can still be adequately furnished by the xylem. An attempt by suitable ringing technique to demonstrate the movement of stored nitrogen from a basal adult region of the shoot upward into the growing tops when sugars were moving downwards was more promising, but the authors recognize that this stored nitrogen may still have moved down to the roots via the phloem and then upwards via the xylem if the nitrogen is released into the trachea in the root.

The later experiment, by Phillis and Mason, is regarded by its authors as giving a more definite answer on the point at issue. The cotton plants in this experiment were all ringed at the base, the basal leaves darkened and one series ringed between the basal region and the apical region. In this case when the plants were starved of all phloem mobile elements, the nitrogen travelled upwards in considerable amount from the basal to the apical region when these were not separated by a ring, whilst little or none entered the apical region when separated by a ring from the basal region.

As carbohydrate was still passing downwards from apical to basal regions in the same plant, these experiments are regarded as supplying good evidence that sugar and nitrogen may travel simultaneously in opposite directions through the phloem.

Science News a Century Ago

The British Association at Bristol

THE work of the British Association at its first Bristol meeting began on Monday, August 22, 1836, there being seven sections, namely, Mathematical and Physical Science, Chemistry and Mineralogy, Geology and Geography, Zoology and Botany, Medicine, Statistics and Mechanical Science. Among the contributors of papers were Brewster, Baily, Lubbock, Whewell, Hamilton, Babbage, Sedgwick, Buckland, Conybeare, Daubeny, Murchison, Dr. Hare of Philadelphia, Lardner, Snow Harris and Scott Russell.

The general meeting of the Association was held on the evening of August 22 in the Theatre, when some 2,000 persons were present. The Rev. Dr. Lloyd, Provost of Trinity College, Dublin, the retiring president, was in the chair, and in the course of his address said that among the purposes of the Association was that "by a more rapid and extensive communication of the lights of science as they are struck out, and by carrying these things home to the doors of all, to awaken to exertion those gigantic powers of mind, which are not confined to a few favoured spots; but which are everywhere to be found; and by establishing a more immediate and intimate communication among those engaged in kindred pursuits, to unite their exertions, as it were, into one simultaneous effort, and thereby to accelerate the progress of discovery in every

line in which the mysteries of nature may be penetrated by the ingenuity and perseverance of man".

At the conclusion of his address, Dr. Lloyd resigned the chair to the Marquis of Northampton, whose first action was to invite some of the ladies present who were without seats to occupy places on the stage, although they were "by law excluded from the platform reserved for the General Committee". His Lordship congratulated the meeting on the great accession of members the Association had received at Bristol. "Here," he said, "were men of every shade of denomination and opinion engaged in one united effort in the cause of science and truth—eminent men from foreign lands, united by the glorious brotherhood of mind, were here assembled to cement the intellectual union of nations. This he regarded as a political result of the highest and most gratifying order. The moral effect of the Association arose from truth being the great object of all its labours."

Death of Louis-Marie-Henri Navier

ON August 23, 1836, the eminent French engineer Louis-Marie-Henri Navier died in Paris at the age of fifty-one years. He was the son of a well-known lawyer of Dijon, where he was born on February 15, 1785. As a boy, owing to the death of his father, Navier came under the influence of his uncle Émilien-Marie Gauthey (1732–1806), an inspector-general of the Corps des Ponts et Chaussées. At the age of seventeen years, he entered the École Polytechnique and two years later the École des Ponts et Chaussées, the Government school for civil engineers founded in 1747 under the directorship of Perronet, and in 1804 directed by Prony. The mathematical training Navier received in these famous schools was reflected in all his later work. His first literary work was the publication of his uncle's "Traité de la Construction des Ponts", 1813. In 1819 he was made a professor of mechanics in the École des Ponts et Chaussées, and in the same year contributed to the Paris Academy of Sciences his "Mémoire sur la flexion des verges élastiques courbes", which was followed by his "Mémoire sur les lois de l'équilibre et du mouvement des corps solides élastiques", 1821, and his "Rapport et mémoire sur les ponts suspendus", 1824. In 1827 he investigated the general equations of equilibrium of an elastic solid, starting from an assumption as to the molecular constitution of matter.

While engaged in teaching and writing, Navier was responsible at the same time for the design of bridges, among which was a chain suspension bridge over the Seine at the Invalides in Paris, the bars for which he required to be tested to 11 tons per sq. in. Constructed in 1826, unfortunately one of the pylons failed, and the bridge had to be taken down. It was afterwards shown by Prony that the mishap was due to circumstances the designer could not have foreseen. The incident for a time had an unfavourable effect on Navier's reputation; but the esteem in which he was held was shown by his appointment in 1830 to the chair of analysis and mechanics at the École Polytechnique. Two years before his death he was given the rank of divisional inspector in the Corps des Ponts et Chaussées. His collected works were published after his death, and to the third edition of them Saint Venant added many valuable notes and corrections.

Christoph Wilhelm Hufeland (1762-1836)

CHRISTOPH WILHELM HUFELAND, physician, author, editor and philanthropist, the centenary of whose death falls on August 25, was born at Langensalza in Thuringia on August 12, 1762, the son and grandson of court physicians at Weimar. After studying medicine at Jena and Göttingen, he qualified in 1783, his inaugural thesis being on the value of electricity in asphyxia. For the next ten years he remained in practice at Weimar, where he was brought into close contact with Goethe, Schiller, Wieland and Herder, as well as with members of the court. In 1793, he was invited by the Duke of Weimar to accept a professorship at Jena, and his lectures attracted considerable attention. In 1880 he succeeded C. G. Selle as royal physician at Berlin, where he became director of the Medico-Chirurgical College and senior physician to the Charité Hospital.

Hufeland was an extremely prolific writer, more than four hundred articles being attributed to him, but his best known works are "Makrobiotik" (1805) or the art of prolonging life, which was translated into every European language and passed through eight editions, and "Encheiridion Medicum; or Manual of the Practice of Medicine", of which six editions were published, an English translation appearing in 1842. Of the four medical journals which he edited, the best known is the *Journal der praktischen Arzneikunde und Wundarzneikunst*, which he founded in 1795 and edited until his death in 1836, after which it continued until 1844.

Hufeland was an enthusiastic supporter of Jenner, and did much by his influence to diffuse the practice of vaccination throughout Germany, in addition to founding a vaccine institute at Berlin. He took an active part in the sanitary reorganization of Berlin, recommended the general use of warm baths and deprecated the abuse of spirits. In 1810 he founded a medical polyclinic, the first of its kind in Germany, for the treatment of the indigent poor, and for the next twenty-four years published annual reports of its activities. Finally, he did much useful work in combating popular errors concerning the Brunonian system of philosophy, mesmerism and phrenology. He was generally regarded as one of the noblest characters of his age.

Sudden Deaths and Suicides in Russia

ACCORDING to the *Gazette des Hôpitaux* of August 25, 1836, official reports show that during the course of 1832, 405 persons, of whom 324 were men and 81 women, died a sudden death in St. Petersburg. In 1833 the figures were considerably higher; 569 such deaths (353 in men and 216 in women) being registered. Most of these deaths were the result of intemperance. It is rare in St. Petersburg, the report continues, as in all the large towns in Russia, for public rejoicing not to cause the death of a large number of individuals. In 1833, for example, 78 men and 24 women were picked up in the streets of the capital whose deaths were due to drunkenness and cold. It is a well-known fact that in Russia, those who are so imprudent as to fall asleep in the open air after excessive consumption of strong drink never wake up again. In the course of the triennium 1831-33, 104 suicides were committed in St. Petersburg. It was noted that young persons made use of firearms or sharp instruments almost exclusively, while old people preferred drowning or hanging.

Societies and Academies

Dublin

Royal Dublin Society, June 23.

P. O'CONNOR: A contribution to knowledge of Irish fungi. A complete list of the fungi recorded by the author in Ireland during the past three years, with sites, dates and host plants and trees. A number of the species have not previously been observed in Ireland, and a few are new to the British Isles.

P. A. MURPHY and J. B. LOUGHNANE: A comparison of some Dutch and Irish potato mosaic viruses.

PHYLLIS CLINCH, J. B. LOUGHNANE and P. A. MURPHY: A study of the aucuba or yellow mosaic of the potato.

H. H. POOLE and W. R. G. ATKINS: The standardization of photo-electric cells for the measurement of energy. The cells and colour filters used for the measurement of daylight have been standardized by means of a standard filament lamp so as to enable the radiant power per square centimetre in various parts of the spectrum to be found in absolute units. The relatively low temperature of the standard source and the relatively large effect of errors in its assumed colour temperature reduce the accuracy of the results.

J. LYONS: The influence of chemical composition on the firmness of butter. The exceptional firmness of New Zealand and Australian butters as compared with Danish and Irish butters is attributed to the relatively low unsaturated fatty acid content and high stearic acid content of the former.

J. A. C. TEEGAN: The comparison of γ -ray intensities from radium preparations. A valve method of measuring the ionization current allows the natural leak to be compensated, and is very rapid and convenient for routine measurements.

Paris

Academy of Sciences, July 6 (*C.R.*, 203, pp. 1-136).

LUCIEN CAYEUX: The reticulated structure of the silica observed in pre-Cambrian phanites and Suessonian phosphates.

MARIN MOLLIARD: The yield of green plants as a function of the proportion of oxygen in the atmosphere. With the radish as the experimental plant, the maximum yield was obtained with an atmosphere containing 5 per cent of oxygen, and the high yield coincided with a more intense green. It is suggested that, with proportions of oxygen above 5 per cent, some oxidation of the chlorophyll pigment may take place.

SERGE WINOGRADSKY: Researches on the morphology and physiology of *Azotobacter* in the soil.

PIERRE LEJAY: New determinations of the acceleration of gravity in France. A table is given showing the values of g for 57 new stations.

MAURICE NICLOUX: The identification of ethyl alcohol.

MILLE ELISABETH LUTZ: The solutions of the equation $y^2 = x^3 - Ax - B$ in \mathfrak{p} -adic bodies.

ANDRÉ WEIL: The \mathfrak{p} -adic elliptic functions.

WOLFGANG DÖEBLIN: The discrete chains of Markoff.

JEAN-ANDRÉ VILLE: The notion of the collectif.

E. J. GUMBEL: Floods and the theory of the greatest value.

CHRISTIAN PAUC: Some local properties of Euclidian continua.

JULES GÉHÉNIU: The generalization of Th. De Donder of Hilbert's theorem of independence.

S. MANDELBROJT and NORBERT WIENER: Lacunous Fourier's series. Direct theorems.

CHARLES PLATRIER: The problem of Barré de Saint-Venant in a homogeneous medium which is deformed starting from a state of constraint.

NICOLAS STOYKO: The irregularity of the earth's rotation. From a comparison of data obtained at Charlottenburg (0.35 sec.) and at Paris (0.39 sec.) over the period October 1934–August 1935, there appears to be a retardation in the rotation of the earth of 0.37 sec.

RENÉ DUGAS: A definition of the validity of quantic mechanics.

PIERRE VERNOTTE: The theoretical dimensions of the cellular vortices of Bénard.

LÉON DUBAR: The influence of the gases of the atmosphere on the electrical conductivity of cuprous oxide. After a preliminary heating in a vacuum, contact with oxygen causes a regular increase in conductivity. This increase is removed by admitting water vapour.

M. LAMBREY and S. KRAUTHAMER: The abnormal combinations of frequencies of conversion values.

EMILE PIERRET: The properties of triodes with large diameter plate in very high frequencies. Triodes with plate of large diameter can be used for the production of oscillations of very short wavelength, and the frequency can be varied between certain limits as a function of the voltage of the plate. This arrangement is specially useful in measurements of dielectric constants.

J. HENRIOT: Dielectric losses in an alternating field of high frequency and molecular dimensions. The experimental results given show that the method can be advantageously applied to the determination of mean molecular dimensions.

J. SWYNGEDAUF: A new electro-chemical method of preparing proteins in the isoelectric state.

THÉODORE V. IONESCU: The true periods of vibration of ionized gases in the magnetic field.

JACQUES STOHR: An arrangement with self-induction circuit for determining the derivative with respect to time of a function represented by an electric current.

MARCEL LAPORTE and FRANÇOIS GANS: The physical photometry of tubes containing luminescent gas.

ROBERT BOSSUET: The search for the alkaline metals in natural waters. The waters examined came from Corsica, Algeria, Tunis and Madagascar. The results are classified under two headings: those containing all five alkali metals, and those not containing caesium.

(To be continued.)

Brussels

Royal Academy (*Bull. Classe Sci.*, No. 5, 1936).

L. GODEAUX: Cyclical involutions of the third order and genus one belonging to an algebraic surface.

P. FOURMARIER: Some observations on slaty cleavage in the Palaeozoic regions of north Devon and north Cornwall.

E. W. BETH: Proof of a theorem concerning the principle of the excluded third.

M. BARZIN: Note on M. E. W. Beth's proof.

G. HIRSCH: Logical foundations of the theory of probabilities.

B. GAMBIER: Study of the cubic surfaces which can possess Eckardt points.

L. FALLA: An involution of the second order, the groups of which belong to the radii of a linear complex.

YVONNE DUPONT: Theory of elastic deformations in space-time.

J. VAN MIEGHEM: Intrinsic form of the conditions of compatibility. Application to the calculation of potential discontinuities.

M. DÉSIKANT and A. MINNE: Researches on the 'fluctuation bands' of the diatomic vapour of tellurium.

Geneva

Society of Physics and Natural History, June 4.

ARNOLD PIOTET: The heredity of a novelty in fur: the silver guinea pig.

CHARLES BAEHNI: A case of generic convergence in the Iridaceæ. Normal *Geissorhiza* and abnormal *Antholysa*.

PAUL ROSSIER: (1) The calculation of the apparent diameter and effective wave-length of stars. (2) The effective photographic wave-length. (3) The width of the lines of stellar hydrogen.

FERNAND LÉVY: The local distribution of the pressures in an elastic medium.

L. W. COLLET and ED. PAREJAS: (1) Contribution to the study of the Salève Tertiary. (2 and 3) The region comprised between Esserts and Ussets, and a general survey.

June 18.

A. MERCIER: The relations between the spinorial and Clifford magnitudes.

R. WAVRE: The four logarithmic potentials of a circumference.

F. BEER: The extension of the Hadamard-Schmidt theorem to the case of the logarithmic potential created by a real body in a complex domain.

K. H. MEYER and BRENTANO: Researches on maize starch.

E. C. G. STUECKELBERG: The absolute electro-magnetic potential as a new property of light.

July 2.

P. WENGER, CH. CIMERMAN and G. TSCHANUN: The electrolytic microdetermination of zinc, and its application to brass.

CH. CIMERMAN and P. WENGER: The volumetric microdetermination of zinc.

E. PERROTTET and B. SUSZ: The Raman spectra of the *cis* and *trans* isomers of isoeugenol.

S. FRIED and B. SUSZ: Note on the Raman spectrum of the trimethyl ether of oxyhydroquinol.

P. ROSSIER: Discussion of the spectrograms of the B5 stars.

J. BUFFLE: Observations on the surface waters and deep waters of the canton of Geneva.

DOM ZIMMET: (1) The use of the nickel-nitroprusside reagent as an external indicator in the determination of reduced glutathione with iodine. (2) The amount of glutathione in some oil-producing plants: walnut, Brazil nut, hazel nut, almond and peanut. (3) The biological analogy between the bile acids and the sterols. The influence of the bile salts on the growth and morphogenesis of tadpoles.

Rome

Royal National Academy of the Lincei
(*Atti*, 23, 3-92; 1936).

U. CISOTTI and A. MASOTTI: Ballast effects in space. G. A. MAGGI and B. FINZI: Conditions at the wave-front and harmonic electro-magnetic waves.

E. BORTOLOTTI: Non-linear relations: geometry of a system of equations with partial derivatives of the second order. Preliminary (1).

O. CHISINI: Branching curve of multiple planes.

G. PALAMÀ: Two new generalizations of Vandermonde's determinant.

B. CALDONAZZO: Free regulating source in the problem of a lamina.

G. LAMPARELLO: Asymptotic irrotational motion of every stationary current of a perfect fluid subjected to conservative forces.

G. D. MATTIOLI: Second form of the equations of turbulence according to the hypothesis of a single direction of transport (1). Energetic equation of turbulence and conditions of integration of indefinite equations (2).

G. NEBBIA: Tracing the shapes of gradually varying permanent liquid currents.

E. JOLLES: Derivatives of the azoxy-carboxylic acids.

C. ANTONIANI and A. SPICA CLERICI: Glucidic metabolism of the mammary gland *in vitro*.

M. FENOGLIO: Vogesite from Ginepro (Elba).

A. MESSERI: Primary organizing sieve tissue of the secondary cambium.

G. NEGODI: Contribution to the cariology of *Calandula* (L).

M. VENTURA: Some embryological data of *Sapium sebriferum* (L.), Roxb.

(*Atti*, 23, 95-159; 1936).

G. ANDRUETTO: New expression for the total curvature of a surface (1). Geodetically parallel lines and hyper-surfaces (2).

E. BORTOLOTTI: Non-linear relations: geometry of a system of equations with partial derivatives of the second order. Intrinsic properties of the system (2).

U. BROGGI: Determinant functions and polynomials of Laguerre.

L. CROCCO: New function of a current for the study of the rotational motion of gases.

G. KRALL: Equations of vibratory motion of a bridge traversed by inert and pliant loads (1). Limits for the vibrations of any bridge traversed by mobile loads with uniform motion (2).

A. MASOTTI: Planar motions produced from two vortex sources.

A. BARONI: Sulphide, selenide and thioselenide of thiocyanogen. The preparation of $\text{Se}_2(\text{CNS})_2$, of $\text{SeS}(\text{CNS})_2$ and of $\text{S}(\text{CNS})_2$ is described. All these substances polymerize readily at ordinary temperatures.

O. BOTTINI: Thermal decomposition of NH_4 -clays.

E. PARISI and G. DE VITO: Contribution to the knowledge of the ripening of cheeses. Polypeptides containing phosphorus (2). By the action of proteolytic enzymes fragments of relatively low molecular weight, which contain practically all the phosphorus of the original substance, are broken off from the casein molecule.

M. BENAZZI: Influence of the cephalic region on the movement and sensitivity of tricladic Planaria.

T. PERRI: Growth of the crystalline in anurid Amphibia (2). Experiments on *Rana esculenta*.

Official Publications Received

Great Britain and Ireland

Department of Scientific and Industrial Research. Forest Products Research Records No. 11 (Timber Series No. 3): The Properties of Home-Grown Oak. Pp. ii+14. (London: H.M. Stationery Office.) 6d. net. [307]

Empire Cotton Growing Corporation. Report of the Executive Committee to be submitted to the Meeting of the Administrative Council on July 28th, 1936. Pp. 6. (London: Empire Cotton Growing Corporation.) [307]

The National Institute of Poultry Husbandry: Harper Adams Agricultural College. Bulletin No. 12: Turkey Production. By A. J. Macdonald and Margaret S. Miller. Pp. 8. (Newport, Shropshire: Harper Adams Agricultural College.) 3d. [307]

Anarchy or Peace? By Lord Davies. (Series D/No. 10/Int.) Pp. ii+17. (London: The New Commonwealth.) 9d. [317]

City of Leicester Museum and Art Gallery. Thirty-second Report to the City Council, 1st April 1935 to 31st March 1936. Pp. 32+2 plates. (Leicester: Museum and Art Gallery.) [317]

Committee on Bird Sanctuaries in Royal Parks (England). Report for 1935. Pp. 27. (London: H.M. Stationery Office.) 6d. net. [317]

The Scientific Proceedings of the Royal Dublin Society. Vol. 21 (N.S.), No. 36: The Chemical Constituents of Lichens found in Ireland—*Buellia caescens*, Part 2. By P. A. Spillane, Dr. J. Keane and Dr. T. J. Nolan. Pp. 333-343. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 1s. [48]

Other Countries

Transvaal Museum. Report for the year ended 31 March 1936. Pp. 23. (Pretoria: Transvaal Museum.) [287]

Sudan Government: Agricultural Research Service: Chemical Analytical Section. Report of the Government Chemist for the Year 1935. (Chemical Section: Publication No. 78.) Pp. 23. (Khartoum: Agricultural Research Service.) [297]

Memoirs of the Faculty of Science and Agriculture, Taihoku Imperial University. Vol. 18, No. 1 (Mathematics No. 18): On a Pair of Surfaces mutually Related (3) (4). By Sôzi Matamura. Pp. 19. Vol. 18, No. 2 (Mathematics No. 19): Über Flächen und Kurven (16). Über Ellipnien und Eiflächen; Beiträge zur Geometrie der Kreise und Kugeln (16), von Sôzi Matamura. Pp. 21-74. (Taihoku: Taihoku Imperial University.) [307]

Bernice P. Bishop Museum. Bulletin 137: Dinoflagellates of the Coastal Waters of the Western Pacific. By Anton Böhm. Pp. 54. Bulletin 138: Ethnology of Futuna. By Edwin G. Burrows. Pp. iv+239+11 plates. Bulletin 139: Marquesan Insects; Environment. By A. M. Adamson. (Pacific Entomological Survey: Publication 9.) Pp. ii+73+8 plates. Bulletin 140: Report of the Director for 1935. By Herbert E. Gregory. Pp. 52. (Honolulu: Bernice P. Bishop Museum.) [317]

Bernice P. Bishop Museum. Occasional Papers. Vol. 11, No. 15: Native Trade in Southeast New Guinea. By Laura Thompson Tueting. Pp. 43. Vol. 11, No. 16: Effect of X-Rays on Regeneration of Chelipeds of *Atya bisulcata*. By Charles Howard Edmondson. Pp. 15. Vol. 11, No. 17: Society Islands Pounders. By Henry Silverthorne. Pp. 17. Vol. 11, No. 18: Check List of the Serphoidea, Bethyloidea and Anteonidae of Oceania. By Robert Fouts. Pp. 15. Vol. 11, No. 19: The Hawaiian Silverswords; Systematics, Affinities and Phyto-geographic Problems of the Genus *Argyroxiphium*. By David D. Keck. Pp. 38. Vol. 11, No. 20: Contribution to the Mosses of Fiji. By Edwin B. Bartram. Pp. 30. Vol. 11, No. 21: Notes on the Flora and Fauna of Lehua and Kaula Islands. By Edward L. Caum. Pp. 17. Vol. 11, No. 22: Two New Species of Terminalia from the Austral Islands and Mangareva. By A. W. Exell. Pp. 4. Vol. 11, No. 23: A New Species of Schideea. By Edward L. Caum and Edward Y. Hosaka. Pp. 5. Vol. 12, No. 1: Review of the Genus *Orochysis* (Coleoptera, Curculionidae). By Elwood C. Zimmerman. Pp. 19. Vol. 12, No. 2: Amarantaceae of Southeastern Polynesia. By K. Suessenguth. Pp. 10. Vol. 12, No. 3: Baridinae of Southeastern Polynesia (Coleoptera, Curculionidae). By Elwood C. Zimmerman. Pp. 8. (Honolulu: Bernice P. Bishop Museum.) [317]

Bernice P. Bishop Museum. Special Publication 26: Proceedings, Hawaiian Academy of Science, Tenth Annual Meeting, 1934-1935. Pp. 21. (Honolulu: Bernice P. Bishop Museum.) [317]

Field Museum of Natural History. Anthropology Leaflet 33: Archeology of South America. By J. Eric Thompson. Pp. 160+12 plates. (Chicago: Field Museum of Natural History.) 75 cents. [317]

U.S. Department of Agriculture. Circular No. 387: Distribution of the Argentine Ant in the United States and Suggestions for its Control or Eradication. By M. R. Smith. Pp. 40. (Washington, D.C.: Government Printing Office.) 5 cents. [48]

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 156: The Optimum Sugar Cane Planting Date in Egypt. By Arthur H. Rosenfeld. Pp. 13+9 plates. 3 P.T. Bulletin No. 179: Water-Weight-Changes in Export and Country Bales. By Dr. W. Lawrence Balls. Pp. 27. 3 P.T. (Cairo: Government Press.) [48]

Annual Report on Forest Administration in Malaya, including Brunei, for the Year 1935. By J. P. Mead. Pp. iii+60+4 plates. (Kuala Lumpur: Government Printer.) 50 cents; 1s. 2d. [48]

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 88. Notes on some South Asiatic Species of the Genus *Cyornis*. By Erwin Stresemann and Rodolphe M. de Schauensee. Pp. 337-351. (Philadelphia: Academy of Natural Sciences.) [58]

League of Nations. The Problem of Nutrition. Vol. 3: Nutrition in various Countries. (Series of League of Nations Publications. II. Economic and Financial, 1936. II.B.5.) Pp. 271. (Geneva: League of Nations; London: George Allen and Unwin, Ltd.) 5s. 6d. [58]

Union of South Africa: Department of Agriculture and Forestry. Bulletin No. 156: Seasonal Variations in the Freezing Point of South African Milk. By Dr. L. Denis-Lester. (Chemistry Series No. 143.) Pp. 14. 3d. Science Bulletin No. 153: The Composition of Pineapples. By J. C. Bodenstern. (Chemistry Series No. 146.) Pp. 14. 3d. (Pretoria: Government Printer.) [58]