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Rubber Research

FREQUENT reference has been made in our columns to the importance of the relations between the State and industry in regard to research. Abundant evidence has been quoted to show that research on materials, methods of manufacture, and the properties of finished products not only benefits the industry concerned but also, directly and indirectly, the whole nation. Recognition of this common interest in research was shown by the grant in 1916 of a special fund to initiate and encourage co-operative research in Great Britain, and by the continuation of grants to the industrial research associations, which came into existence as a result of this policy, long after the end of the trial periods originally contemplated.

We are reminded of this community of interest by the announcement that the thirteen years' partnership between the rubber manufacturing industry and the State, through the Department of Scientific and Industrial Research, is to be dissolved unless assurance is immediately forthcoming that the finances of the Research Association of British Rubber Manufacturers can be established on a stable and adequate basis. The situation demands attention particularly because the fate of the Association now appears to rest with the House of Commons and possibly with the Government.

The Association, initiated in 1919 with fifteen members, has now grown to a membership of eighty-six firms, and is supported in addition by ninety-five subscribing firms and institutions interested in rubber but not qualified as actual manufacturers for full membership. A summary of the twelfth annual report was given in our columns (*NATURE*, 129, 695, May 7, 1932), and from this it is evident that the Association has made itself increasingly useful, not only to its own members, but also to other trade and research associations and Government departments.

In recent years the financing of the Association has become increasingly difficult, partly owing to the industrial depression and partly owing to the constitution of the industry, consisting as it does of a large number of firms varying greatly in size. Some of the larger units, which have supported the Association both financially and scientifically from the beginning, are capable of carrying out research economically in their own factories and therefore take the view that they cannot continue to finance the Association in the common

interest, except under some scheme by which all members of the industry contribute on a proportionate scale. To this end the Association has prepared a scheme by which it would be financed by the proceeds of a levy of one forty-fifth of a penny per lb. on all raw rubber imported into Great Britain, thus spreading the burden uniformly over the units of the whole industry in proportion to their rubber consumption. This levy would secure an annual income to the Association of about £15,000. The scheme has been accepted by the majority of the firms in the industry and approved by the principal trade associations.

The financing of research or development by a levy on a basic material is not without precedent. The Cotton Industry Act of 1922 provides for the encouragement of cotton-growing in the British Empire by a levy on raw cotton; there is a cess on exported rubber for the upkeep of raw rubber research in Ceylon; and there is a levy on coal by which the Miners' Welfare Fund is financed in Great Britain. The idea of a levy for the support of a research association has also been considered favourably by more than one Parliamentary Committee. In its Final Report, the Balfour Committee on Industry and Trade stated:

"We have watched with interest and sympathy the steps taken by the rubber industry to secure the necessary funds for the operation of its research Association through a small levy on imported rubber. We hope that this scheme will receive legislative sanction, and that it may serve as an example to other industries to adopt measures, suited to their special conditions, for placing the finances of their research Associations on a permanently satisfactory basis."

Again, the Committee on New Industrial Development stated in its report:

"We do not consider that any general powers should be taken to enforce compulsory levies for the support of research Associations. Should an industry, however, succeed in working out a practicable scheme involving a compulsory levy for the support of a research Association, which it can show commands the support of a substantial majority of the industry, including the larger concerns, we consider that the Government should be ready to assist the Industry in obtaining the necessary Parliamentary powers."

The proposal for a levy in this case is embodied in the Rubber Industry Bill and has been four times before the House of Commons. When it was last debated, about two years ago, the

opposition was based mainly on the objection of certain firms to compulsory support of an organisation which they considered to be of no value to them. In spite of this objection, the Bill obtained a second reading majority of 148 votes to 10 and passed through Standing Committee, but did not receive a third reading owing to lack of private members' time before the end of the session.

During the past year, a significant change in the situation has occurred. Many British industries, including the rubber industry, are now protected in the home market by a general tariff. Consequently, the technical efficiency of an industry cannot now be regarded as a purely domestic question for the industry itself. Whatever views might have been held a year ago on what the opposing firms called "the inalienable right of the British trader to carry on his trade without interference", it will be agreed that a protected industry should take a much less individualistic view of its obligations to the community, which voluntarily surrenders its right to carry on its buying without interference. In consideration of the benefits conferred by a tariff, the consumer has the right to expect the industry to give its best in return, and will not be greatly impressed by the plea of a minority which objects to a levy amounting on the average to about 1/1800th part of the selling value of its products for the purpose of improving the scientific and technical efficiency of the industry. In these circumstances, there is little doubt what the verdict of the House of Commons would be if the Bill were to obtain another debate and division.

Unfortunately, this seems unlikely to occur; for the prospects of the passage of a private member's Bill against even the slightest opposition are so small that arrangements have already been made for disbanding the staff of the Research Association when its financial resources are exhausted at the end of this month. If the organisation is to be kept together, action must be taken quickly and the only course now left open seems to be for the Government to declare itself in favour of the principle of the Bill and give it facilities for passing through its further stages. Indeed, considering the dependence of all the industrial research associations on State assistance, it is surprising that the Government, once it adopted tariffs, failed to earmark a part of the revenue thus obtained for the more earnest prosecution of research in every branch of industry.

The Cost of a New World Order

After Democracy: Addresses and Papers on the Present World Situation. By H. G. Wells. Pp. vii + 247. (London: Watts and Co., 1932.) 7s. 6d. net.

IN this volume of essays, all the product of the last three years, we have the revelation of the thoughts on our present discontents of a student of science turned publicist and perhaps the most qualified of living writers to express either the implications of the scientific outlook in the life of society or the responsibilities which fall on the shoulders of scientific workers.

There is little sequence or relation between the essays other than that conferred by the author's outlook. They range from parliamentary government, economics, planning and world peace to divorce and morals. Each subject is touched upon in the same openmindedness and readiness to accept the consequences of change and development. Mr. Wells reiterates repeatedly the significant facts which our whole system of government and industry are still disposed to burke—the abolition of distance, the growth of human life into a world-wide community of interdependent human beings—and he has no patience with the prejudices or the stupidity which refuse to accept the situation and to meet the consequences, above all with the neglect of the sovereign governments of the world to accommodate themselves to this fusion of once separate economic systems.

This impatience is apt at times to lead to excessive depreciation of factors which may have real value in the scientific order of society which he visualises as essential for the security of mankind. Thus Mr. Wells's denunciation of the evils of nationalism, and his exposure of its persistent menace alike to world peace and to the economic structure of mankind, lead him to repudiate internationalism almost as forcefully. Is this either logical or wise? The international spirit as evidenced in certain forms of world co-operation, such as the health work of the League of Nations, shows itself at least as practicable as the cosmopolitanism to which Mr. Wells leans so strongly and is at least as likely to promote the development of the sense of world citizenship. A sense of civic and municipal responsibility or pride can be a national asset provided it does not displace or overshadow the larger and greater loyalty to the State as a whole. Nor need we assume that if we succeed in stripping our national governments of

their militant manifestations, whether in military pageantry, armaments or tariffs, the national units may not learn to co-operate effectively and wisely for the good of mankind as a whole. The League at least offers a framework for constructive work, once the militancy of national governments has been replaced by a spirit of co-operation alike in the direction of a world police force or a world economic policy.

So, too, Mr. Wells's well-founded distrust of nationalism leads him to deny or ignore all its spiritual aspects and the rich contribution to civilisation made within the national framework. To the thinker, no doubt the vision of a world State and the allegiance of world citizenship may make a direct and a nobler appeal. But to lesser minds, the lesser loyalties may be more concrete, and rightly orientated may make the more effective appeal. We may yet see the day when the ordinary citizen is proud of his country according to her reputation for honourable dealing and co-operation in the world comity of nations in the same way that he is careful of his own reputation as a just and law-abiding citizen.

If Mr. Wells has dealt with internationalism with rather unmerited severity, his strictures on the rising tide of nationalism and the many agencies that minister to it are well deserved and should indeed be supported and echoed fearlessly by all who wish to see a scientific order of society. The most significant note in the book is indeed to be found in the emphasis placed on education. It is only as man comes to an accurate knowledge of his environment and relates his knowledge to that action that Mr. Wells sees any hope for the world.

Nowhere in the book is this more clearly stated than in the addresses on "Liberalism and the Revolutionary Spirit" and on "The Commonsense of World Peace". In a footnote to the former address Mr. Wells outlines again the ideas recently formulated under the title "The Open Conspiracy". The basis of his "Z Society" is declared to be "the discussion, study, research and propaganda of the sciences of social biology" and "the effective application of their principles to the reorganisation and enlargement of human life". This is nothing else than a challenge to honest, lucid thought about the facts of the situation, and that is basic for the liberation of the world from sectionalism whether national or lesser units are involved. So, too, the basis for world peace lies in the elimination of nationalist teaching and teachers everywhere—the development of a history teaching which leads

us on to the great possibilities of the collective human future. "We need an education that will turn mankind from tradition to hope".

Here indeed Mr. Wells is on firm ground, and if his appeal succeeds in stimulating the wide circle of readers, into whose hands his reputation should carry the book, into thinking out some of these implications for themselves, and into refusing to tolerate the wrong kind of teaching or the perpetuation of obsolete jealousies, and sectionalisms, the first steps towards the new order will have been taken. There is no need to dwell on Mr. Wells's obvious failure to show how the minority dictatorship he conceives in his "Z Society" is to succeed while conceding full freedom of thought and expression. Once the vigour of mind, the willingness to accept new situations, to discard old prejudices, which characterise the distinguished author of this book have gained a firm hold on the minds of men generally, we should be in a fair way to realise his vision. But time presses and the danger that before any such widespread movement of thought can occur our civilisation may have tottered to its ruin, is even more acute than Mr. Wells suggests in his somewhat pessimistic sketch "Our World in Fifty Years Time". It is in fact difficult to see how the vested interests blocking the way to world security can be overcome except as governments are captured through the rapid orientation of some major political party to the outlook for which he pleads. To that orientation scientific workers everywhere might even yet contribute the decisive factor.

R. BRIGHTMAN.

An Imperial City of China

Jehol: City of Emperors. By Sven Hedin. Translated from the Swedish by E. G. Nash. Pp. xiv + 278 + 63 plates. (London: Kegan Paul and Co., Ltd., 1932.) 18s. net.

THIS book has its origin in the desire of the author's fellow-countryman, Mr. Vincent Benedix, of Chicago, to erect a Lamaist temple, either an original or a replica, in Stockholm and another in Chicago. Sir Sven Hedin, to whom the commission was entrusted, elected to make a replica of the Golden Temple in Potala of Jehol, the city which was once the summer residence of the Manchu emperors. The plans and drawings were made and the material collected—even down to the paint—in the summer of 1930 with the assistance of Chinese architects and draughtsmen.

At the time this book was being written, the replica for Chicago, with the accessories of the ritual, had reached its destination and was awaiting erection.

The Potala of Jehol was constructed after the model of the Potala, the famous temple-monastery of Tashilhunpo in Tibet, and was completed in the year 1771. Its erection marked two important events, the gathering of the vassal princes and chiefs, who had recently sworn allegiance, to congratulate the Emperor Ch'ien Lung on his sixtieth, and his mother on her eightieth birthday, and the return to China of the Turgot, or Kalmuks, from Russia after an expatriation which had lasted for one hundred and seventy years. This was also the occasion of a visit to the Emperor of the Tashi Lama, the greatest figure in Northern Buddhism of that era. His death while at Jehol was a misfortune for Buddhism.

Sir Sven Hedin has availed himself of the opportunity afforded by his stay in Jehol to produce an illuminating account of that city as a setting for the Manchu spirit of imperial rule. It is situated some 114 miles from Peking, just outside the Great Wall, and has been described as the Fontainebleau of China. The author has made no attempt to describe its many temples, pavilions and ceremonial buildings in detail, but confines himself to a brief account of the Potala, the Hsin Kung temple-monastery, which was erected to accommodate the Tashi Lama when he visited Ch'ien Lung, the "Temple of the Great Buddha", and one or two more of note.

It is, however, on the historical side of his subject that the author is at his best. He deals with the lives of three great figures of the Manchu dynasty associated with Jehol—the Emperor K'ang Hsi (1662–1722), Ch'ien Lung (1736–1796) and the Manchu concubine Yehonala, better-known to Europeans as the Dowager Empress, who dominated China from 1861 almost up to the day of the Republic. In his account of the two emperors who made China one of the great empires in the history of the world, the author has supplemented European sources, which for the most part are readily accessible, by Chinese records, some not previously translated. Here he has had the assistance of Chinese scholars. These documents are a revelation in so far as they indicate the principles of Chinese imperial policy and even more the Chinese point of view in dealing with the western world. Ch'ien Lung's letter to King George III, in reply to Lord Macartney's

embassy of 1792, when viewed in the light of these records, may even serve to assist in the interpretation of recent history in the Far East and Chinese international relations in modern times. There is much to be said on the side of China, as well as in extenuation.

A disturbing account is given of, in some instances, the decay, and in others of the destruction, of irreplaceable gems of art and architecture in this now neglected city. The recently aroused interest of China in her antiquities should not be suffered to neglect even the work of the Manchu dynasty.

In two chapters, one dealing with the march of the funeral procession of the Tashi Lama from Jehol back to Tibet, the other with the flight of the Turgot from Russia, the author's wide and intimate knowledge of central Asia has been drawn upon for two of the most graphic and moving pieces of description in an absorbing book.

Modern Genetical Studies

Recent Advances in Plant Genetics. By Dr. F. W. Sansome and J. Philp. Pp. x+414. (London: J. and A. Churchill, 1932.) 15s.

GENETICS, in the broadest sense, is advancing so rapidly, and by so many different methods, that it has already become impossible for either the specialised research worker or the teacher of biology to keep in touch with all the latest discoveries and theories by reading the numerous original publications. Moreover, the literature is so scattered through scores of periodicals that only a very large library can contain even an essential part. For these reasons alone the publication of a book, which, though not of the nature of a general textbook of genetics, summarises the results of research, mainly of the last ten years, must be welcomed by a large number of biologists.

Within the limits deliberately set out in the preface, Dr. Sansome and Mr. Philp have chosen their material most judiciously. It is to be regretted that considerations of space made it impossible to deal more fully with sex in plants, chimæras, and the mathematics of inheritance and populations. A clear exposition for the general worker and 'honours student' of the last subject especially would be of very great value, and the hope may be expressed that a supplementary volume to that now under consideration may be published and include both the biometrics of evolution and

genetics and a fuller account of the relationship of genetics to the wider problems of evolution.

Throughout the ten chapters the predominance of cytological methods in modern genetical studies is very evident. An extensive study of chromosome numbers and morphology is leading to a more direct investigation of genic reaction than is possible by breeding alone, but the various kinds of genes (or factors) now recognised have still to be designated almost always from the somatic effects they produce and not from their own nature. In the chapters dealing with the chromosome theory of heredity, and those on polyploids, the reader will find a most valuable summary, illustrated with figures and tables, of the more important of the many recent researches showing the close connexion between chromosomes and the appearance and behaviour of characters in plants. The complexity of structural hybrids and the results of interspecific hybridisation in such genera as *Galeopsis*, *Triticum*, *Nicotiana*, *Crepis*, *Viola*, and *Antirrhinum*, can again only be interpreted satisfactorily when breeding results are correlated with cytological investigation.

The long bibliography (47 pages), of properly quoted references, occupying as it does more than one-tenth of the book, indicates how rapidly the subject has advanced in recent years and suggests that there will soon be a need for another work of a similar kind. The chapter entitled "Conclusions" is, therefore, of a tentative but optimistic nature.

The principles of Mendel have been modified or extended in scope but have stood the test of thousands of experiments with the need for less basic alteration than, perhaps, has been needed by any other original biological theory. Recognition of the interaction of factors with one another and the modifying influences of the environment has led geneticists to a unitary biological point of view. Only hypotheses as to the methods of factor action, how ontogeny is genically controlled, are yet available and probably concern the biochemist and biophysicist more immediately than the geneticist. Combined investigations, however, such as those on flower colour in *Dahlia*, will give facts for testing and improving these provisional suggestions. In another direction the application of combined genetical and ecological methods and results to 'species problems' has already opened up a fascinating field where efficient team-work must include the taxonomist and student of geographical distribution.

It is evident that the work under notice should

have a wide appeal at the present time, that it fills, at least temporarily, an important gap in English biological literature, and that it should stimulate a wider and deeper interest in a subject of more than academic importance. W. B. T.

Chemical Examination of Explosives

Chemische Untersuchung der Spreng- und Zündstoffe: unter besonderer Berücksichtigung der zu ihrer Herstellung notwendigen Ausgangsstoffe. Unter Verwendung eines von Hermann Kast hinterlassenen Manuskriptes. Herausgegeben von Ludwig Metz. Pp. x+583. (Braunschweig: Friedr. Vieweg und Sohn A.-G., 1931.) 40 gold marks.

THIS book is practically a demi-official publication as it embodies much of the experience accumulated by the "Centrallstelle für wissenschaftlich-technische Untersuchungen" and the "Militärversuchsammt" up to the time of the Armistice, when they were abolished, and by the "Chemisch-technische Reichsanstalt" which was established afterwards. It is not likely that in any country other than Germany a volume of nearly 600 pages, costing £2 at par, would be published dealing with such a specialised subject. The title does not give a very accurate idea of the scope of the book, for about sixty per cent of it is devoted to smokeless powders and their raw materials and other products which are not strictly either "Sprengstoffe" or "Zündstoffe". The same objection applies, however, to the title of Kast's companion volume "Spreng- und Zündstoffe" published in 1921, which dealt with the manufacture and properties of explosives. Presumably the more comprehensive title "Explosivstoffe" was avoided because it is not a purely German word—an illustration of one of the minor disadvantages of the excessive development of nationalist feeling. The authors, however, have not ignored the work done in countries other than their own.

About half the volume deals with the raw materials used in the manufacture of explosives. Naturally there is nothing very original in these sections, but it will be convenient to the explosives chemist to have the information collected together. It is more in the methods of testing the explosives themselves that the authors' experience will be found of special value.

Some seventy pages are given to stability tests; 40 of these pages dealing with nitrocellulose and

25 with smokeless powders. Like others who have had to deal with this elusive subject, the authors concluded that there is no single test which is really satisfactory, and it is consequently desirable to test a sample by two or more methods. Those favoured, especially for fibrous nitrocellulose, are the well-known Bergmann and Junk test at 132° C. and a storage test at 75° C. In the latter, 5 gm. of the dried explosive is heated in a long stoppered tube for some days until red fumes appear.

In the manufacture of smokeless powders the most important development of recent years has been the introduction of non-volatile gelatinisers which are also efficient stabilisers. They assist in converting the fibrous nitrocellulose into a hard horn-like mass and at the same time act as negative catalysts to the thermal decomposition of nitric esters. Of these substances the most important is "Centralite No. 1", diethyldiphenylurea, which was patented by Claessen so long ago as 1906, but does not appear to have been used on a large scale before the War. Its use enabled the Germans to dispense altogether with the use of volatile solvents in making nitroglycerine powders, and consequently the lengthy drying process was eliminated. With nitrocellulose powders, containing no nitroglycerine, it has not been found practicable to dispense with the volatile solvent, ether-alcohol, because the powder mass is too stiff, even at a temperature of 80° C., to be worked up without danger of explosion. It is, however, added to these powders as a stabiliser, and the surface of the grains is often treated with "Centralite" to make the powder burn in a more progressive manner. Since the War, "Centralite" has been adopted by other countries for the manufacture of their smokeless powders. Kast and Metz give considerable information about the chemistry of this and other similar substances, and a number of methods for its estimation in smokeless powders.

Lead azide, which is now used largely as a substitute for mercury fulminate, is also dealt with adequately. Lead styphnate (trinitroresorcinate), which is added to azide to make it more ignitable, is treated briefly, and some information is given about other comparatively new explosives, such as pentaerythritol tetranitrate.

In consequence of the general plan of the book, the same substance is dealt with in a number of different places, but as there is a good subject index this introduces no serious difficulty. There is no index of authors.

ARTHUR MARSHALL.

Short Reviews

- (1) *Elementary Textile Design and Fabric Structure*. By John Read. Pp. 95. (London: Edward Arnold and Co., 1931.) 5s.
- (2) *Textile Design and Colour: Elementary Weaves and Figured Fabrics*. By William Watson. Third edition, with Appendices on the Manufacture of Rayon (Artificial Silk) and Standard Yarns, Weaves and Fabrics. Pp. xi+476. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1931.) 21s. net.

BOTH these books are restricted to the consideration of elementary weaves; but Mr. Read's is also designedly elementary from the instructional point of view, consisting in the main of a series of exercises, whereby the beginner may proceed, step by step, to gain useful knowledge of his subject, and it is well adapted for the purpose. Mr. Watson's book is of a more substantial character, and it displays a grasp of the technique and is accompanied by a wealth of diagram and illustration, that render its value indisputable, even were the latter not suggested by the fact of this being the third edition.

Mr. Watson, like some other present-day writers, seems to hold a different view as to spectrum colours from that held by Sir Isaac Newton and other pre-twentieth century men of science; he writes of six spectrum colours, in place of seven, and regards green (not yellow) as one of the spectrum primaries; in consequence, his views as to the complementaries also differ. Mr. Read's book would have benefited by a freer use of half-tone illustrations of representative fabrics, such as are so liberally introduced by Mr. Watson. The latter's illuminating description of the Jacquard loom and its practical application, and the appendixes dealing with standard fabrics and rayon manufacture sensibly increase the interest of the work.

P. L. M.

Spencer's Scientific Correspondence with Sir J. G. Frazer and Others. Edited by R. R. Marett and T. K. Penniman. Pp. xi+174. (Oxford: Clarendon Press; London: Oxford University Press, 1932.) 10s. net.

IN one sense this volume of letters selected from the correspondence of the late Sir Baldwin Spencer is a companion to the journal of the last journey to Tierra del Fuego on which he died. Both in the journal, and in the letters dealing with his work to his friends and co-workers in anthropology, Spencer reveals the inner working of his mind in its reaction to the subject matter of his research and to the ideas suggested in the comments of his correspondents. The letters selected for publication in this volume begin in 1896, the earliest being addressed to Lorimer Fison; the latest is to Dr. R. R. Marett, being dated April 27, 1929, within a short time of his death. By far the greater number, however, are directed to Sir James

Frazer, and the editors, happily, have included those sent to Spencer by Sir James in reply. Among other correspondents are Dr. Henry Balfour and Walter E. Roth.

This record of an exceptional personality will be valued by Spencer's friends; but as a collection the letters are of more than sentimental value. As the correspondence, for example, with Sir James Frazer proceeds, it is possible to note the gradual development of Spencer's grasp of the meaning of the material he had gathered, and the testing and modification of the hypotheses which, in their final form, were to become to the anthropologist as household words. Most instructive of all is the interchange of idea and suggestion between Spencer and Frazer in which an ideal co-operation between field-worker and theorist was maintained through many years.

The Social and Economic Aspects of the Drink Problem. Pp. 180. (London: Victor Gollancz, Ltd., 1931.) 5s. net.

THIS is the report of a social and economic committee consisting of Prof. A. L. Bowman, Prof. A. M. Carr-Saunders, Sir James Hamilton, Sir John Mann, Mr. B. Seebom Rowntree, Mr. Cecil Rowntree, Sir Edgar Sanders, and Mr. F. D. Stuart, the honorary secretary. The only injunction was that the report was to be absolutely free from bias, and no attempt was to be made to stress either the good or the bad qualities of alcohol. We may assume therefore that the conclusions arrived at are impartial. They are very interesting. During recent years there has been a large reduction in the consumption of alcoholic liquor. At the present time and under prevailing conditions, drink is not seriously impairing industrial efficiency. Heavy drinking is most noticeable among the labouring and casual classes. The proportion of income spent on drink is about the same on the average as before the War. The poverty-creating effect of drink is little, if any, less. Drink is the cause of about forty per cent of the more common offences dealt with at the public courts. About fifty per cent of cases of assault and wilful damage are due directly to drink. The contribution of the liquor trade to agriculture does not appear to exceed nine millions a year.

The book makes excellent reading, but the difference of opinion of the various witnesses is so great that it is difficult to assess the true value of much of the conclusions to which we are apt to come.

The Journal of the Institute of Metals. Vol. 49. Edited by G. Shaw Scott. Pp. 416. (London: Institute of Metals, 1932.) 31s. 6d.

THE subject of corrosion, in one form or another, occupies a prominent place in this volume. The Autumn lecture by Dr. Gough gives the most

complete account yet available of corrosion-fatigue, an effect which is found more and more to be responsible for the failure of stressed parts in practice, as the conditions are more carefully studied. It is concluded with much probability that stress as such is not an important factor; it is rather strain which is important, especially in its effect on protective films. A further communication by Gough and Sopwith shows that atmospheric air must be regarded as a corrosive agent in fatigue tests on most metals, so that the standard of reference should not be the fatigue limit in air but *in vacuo*. Other communications deal with accelerated and prolonged corrosion tests and with the artificial production of green patina on copper, an example of corrosion deliberately produced and controlled. The electrolytic production of a coating of basic sulphate is found to give the best results.

The technical side of the manufacture of non-ferrous metals is represented by papers on moulds for strip casting and on hot-rolling, whilst laboratory experiments on the removal of gases from molten metals have an important practical bearing.

The abstracts published by the Institute being now confined to a separate volume, the present volume is composed entirely of original communications.

Constitution-Types in Delinquency: Practical Applications and Bio-physiological Foundations of Kretschmer's Types. By Dr. W. A. Willemse. (International Library of Psychology, Philosophy and Scientific Method.) Pp. viii+266+32 plates. (London: Kegan Paul and Co., Ltd., 1932.) 15s. net.

DR. WILLEMSE is lecturer in psychology in the University of Pretoria. He discusses the relation of delinquency to types of constitution, basing his ideas on Kretschmer's well-known work; the reviewer prefers the division into leptosome, pyknic, and athletic. One of the most interesting chapters in the book is the author's discussion of other typological studies, particularly with those of Jaensch with his "B" and "T" types which correspond roughly with the cyclothymes and schizothymes of Kretschmer. He points out the similarity between the athletic type of delinquent and the epileptic personality. Athletics are very subject to outbursts of anger and aggressiveness, which outbursts would appear in some way to be associated with the adrenal cortex, and according to Berman, also with the pituitary and male interstitial glands. The notorious Kürten, judging from his photograph, belongs to the athletic type of criminal; he was a typical epileptoid. The subjects of this study were boys between the ages of 16½ and 21½ years, and were confined in the Junior Adult Reformatory at Tokai, and at Houtpoort.

Altogether this book is most readable and introduces us to a very interesting point of view towards crime and the criminal.

Co-operation in Marketing Dairy Products. Part I: *Aims and Agencies*; Part II: *Price Plans.* By R. W. Bartlett. Pp. x+299. (Springfield, Ill. and Baltimore, Md.: Charles C. Thomas; London: Baillière, Tindall and Cox, 1931.) 21s. net.

THE bent of the American mind is towards a greater degree of systematisation than is evident in Great Britain; if an American can reduce anything whatsoever to rule and line, tabulation and percentages, he is entirely in his element. The present work conveys this impression very strongly, but there is no doubt that the author educes strong arguments in favour of co-operative action regarding dairy-products marketing, whether in the form of fluid milk and cream, or the many manufactured processes. The name "Piggly Wiggly Stores" (p. 52) is entirely trans-Atlantic, nor need English people wish to rival such nomenclature.

Before co-operation could reach its present position, many difficulties had to be encountered and overcome; and though there may be room for improvement, the advance in this direction made by the United States is notable. The many charts, tables, graphs and diagrams aid in the elucidation of an already lucid text. The health programme of the National Dairy Council (pp. 104-105) is worthy of the closest attention. Whilst the care exercised in the preparation of the text is manifest, it may be recommended that in a future edition greater attention shall be devoted to exact and orderly arrangement of the index.

Talking Pictures and Acoustics. By C. M. R. Balbi. Pp. ix+126. (London: The *Electrical Review*, 1931.) 7s. 6d.

SUCH an up-to-date subject certainly calls for an up-to-date exposition, and this is provided by Mr. Balbi's treatise, which is lucidly introduced by Sir Oliver Lodge.

In a series of nine chapters are sketched out the various points; and so far as a general reader may be expected to grapple with highly technical terms, the subject is brought within such reader's ken. For the scientific workers in filming, the book should be full of suggestiveness. It is satisfactory to note that the fear that deaf people's chief source of entertainment (the moving picture) would be shelved in the near future by reason of the introduction of the 'talkie', is disproved, as "by by-passing some of the electrical energy through a special form of receiver, the audibility afforded can in general be restored to 100 per cent".

One chapter deals with varieties of recording apparatus, and the next considers the various systems of talking apparatus; the accompaniment of clear diagrams and of other illustrations to a well-selected phraseology proves sufficiently attractive. Chaps. v and vi are more directly concerned with the consideration of acoustical properties, and are followed by brief practical notes upon the provision of the ideal studio and the ideal auditorium.

Influence of the Pacific on the Circulation in the South-West Atlantic Ocean

By A. J. CLOWES, Scientific Staff, "Discovery" Committee

FOR some time the ships of the "Discovery" Investigations have been accumulating hydrographic data in the South-West Atlantic in connexion with whaling research, and it is considered that a preliminary account of some of the principal features would be of interest.

The surface water of this area is divided into two main types by two distinct convergence lines. The more southern of these has been named the Ocean Polar Front by Defant¹ and is called by us the Antarctic Convergence, while the more northern is called the sub-Tropical Convergence. Both Defant and Wüst² base the position of the Antarctic Convergence on a chart of the surface currents by Meyer, who places it at approximately 50° S. between 45° W. and 5° E., but between 40° W. and 60° W. it is considered that it forms the boundary between the Falkland and the Brazilian currents in about 40° S. Our intensive work in the South-West Atlantic shows, however, that this boundary is part of the sub-Tropical Convergence, and that the Antarctic Convergence is found in 58° 50' S. south of Cape Horn, and that it continues to the north-east, being found in 49° 50' S. at 40° W.

The waters of the South-West Atlantic may be summarised as consisting of a surface layer of either antarctic water (in the antarctic zone of the ocean) or of sub-antarctic water (in the sub-antarctic zone), below which is found an intermediate layer of relatively warmer and more saline water above the bottom layer, the Antarctic Bottom water. Wüst agrees with Merz that the intermediate layer of warmer and more saline water is of North Atlantic origin; he also states: "Just as Merz could trace the last vestiges of this water (*N. Atlantic Deep water*) as far as about 65° S. in the observations of Brennecke, so in the east the 'Meteor's' observations place the furthestmost limit at 56° S."

The Atlantic Ocean is separated from the Pacific Ocean by the Drake Passage of approximately 450 miles, between South America and the northernmost point of Antarctica at Graham Land. The question arises, What influence has the Pacific on the circulation and composition of the water in the South-West Atlantic? Wüst states that the influence of the Pacific Ocean is of secondary importance. However, our data quickly showed that there is a considerable eastward flow

through the Drake Passage on both sides of the Antarctic Convergence. Moreover, this flow is not confined to the surface layer only but is continuous to the very great depths of the Drake Passage. Thus no water of Atlantic origin passes into the Pacific. Lack of space precludes the reproduction of many diagrams, but the topographical chart for the 600 decibar surface in relation to the 3,000 decibar surface is given in Fig. 1. The chart is constructed by making use of the observed densities at 72 stations of which the greater part lie in the Scotia Sea, and gives the

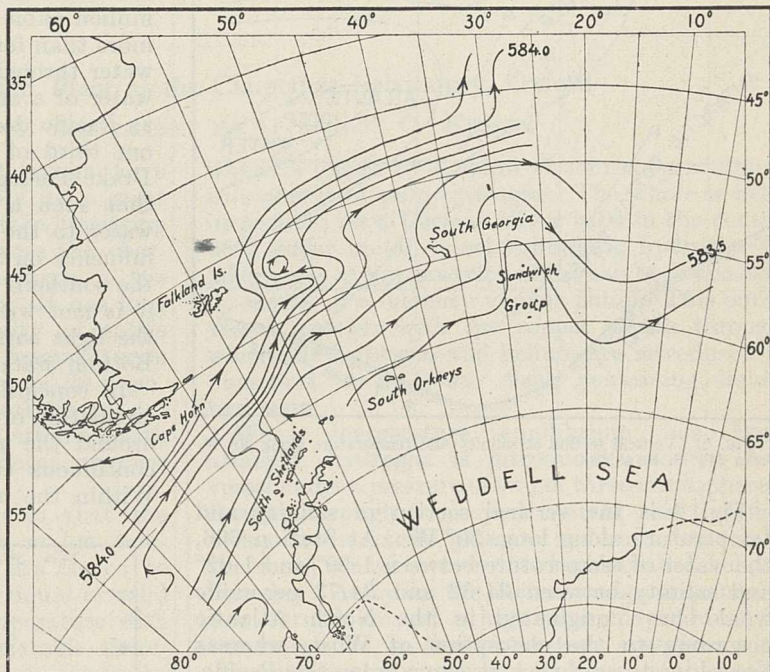


FIG. 1. The currents at 600 metres relative to the currents at 3,000 metres. The lines show the topography of the 600 decibar surface relative to the 3,000 decibar surface.

stream lines of the currents at the level indicated, assuming the velocity at 3,000 metres is zero, or so small that it does not affect the magnitude of currents at lesser depths. The level of 600 metres has been chosen because in the region of South Georgia the maximum temperature of the intermediate warm and more saline water occurs at 600 metres.

It can be seen from this chart that the water flows from the Pacific through the Drake Passage in a north-eastwards direction into the Atlantic, and continues northwards of South Georgia. The great bends of the dynamic isobaths in Fig. 1 between South Georgia and the Falkland Islands, between the South Sandwich Islands and South Georgia, and close to Graham Land are characteristic and permanent features and are related to the topography of the sea bottom, but several

details may be due to the circumstance that observations from different years and seasons have been combined. At the 2,000 metres level the water flows in the same direction as at 600 metres, but the velocities are much smaller. Thus the maximum velocity at 600 metres is about 32 cm./sec. but at 2,000 metres it is about 8 cm./sec.

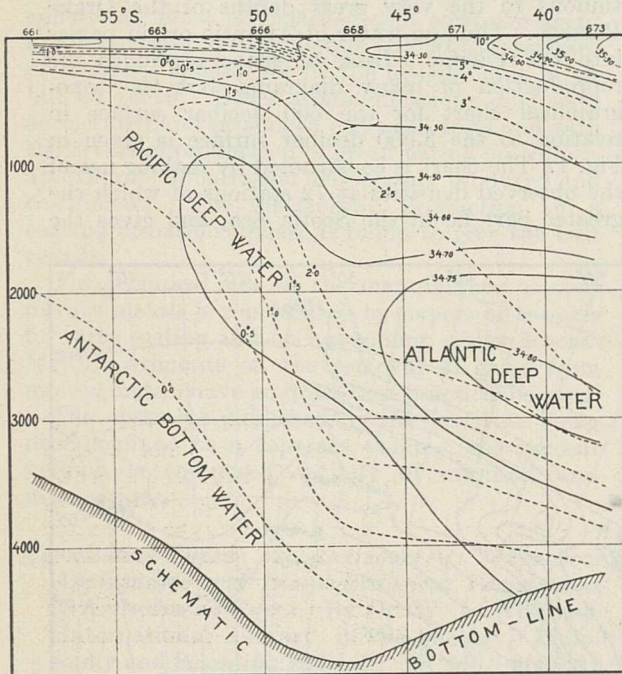


FIG. 2. Vertical section of salinity and temperature along 30° W. from $57\frac{1}{2}^{\circ}$ S. to 43° S.

Fig. 2 is the vertical section of salinity and temperature along long. 30° W. At Station 666, the water of temperature between 1.99° and 1.02° and salinity between 34.62 and 34.73 per mille would have originated in the North Atlantic according to the conception of Wüst, whereas according to our view it came from the Pacific. It has been found by Helland-Hansen that there is a very distinct relationship between temperature and salinity of sea water. Briefly, it may be stated that water masses possessing the same temperature and salinity have a common origin. Thus if we examine the graphs of the relationship between temperature and salinity for a station in the Drake Passage and one or two north of South Georgia, it will be possible to determine the correctness of our view of the water movements in this area. In Fig. 3 the temperature-salinity diagrams for depths below 100 metres have been drawn for three stations, Station 647 in the Drake Passage, and Stations 666 and 671 both north of South Georgia. The agreement between the curves for Stations 647 and 666 is excellent, whereas there is a striking disagreement between the curves for the two former stations and that for 671. Only at depths below 2,000 metres is the water at 666 similar to that at 671 below 3,500 metres, thus showing the

common influence of the Antarctic Bottom water from the Weddell Sea at both stations.

Thus the temperature-salinity diagrams agree with the topographical charts that the warm, more saline intermediate layer in the South-West Atlantic originates in the Pacific. It is only north of 46° S. that the deep water shows a southerly component and is of Atlantic origin; south of 46° S. it is of Pacific origin as far as about 55° S., where the influence of the Weddell Sea is predominant.

On the basis of the sections through the Drake Passage, it is possible to compute the total volume of water which flows from the Pacific to the Atlantic, assuming that the velocity is zero at a depth of 3,500 metres. Using data from two different years, 1929 and 1930, one finds nearly the same values, namely a transport of about 110 million cubic metres a second. This transport is more than four times as great as the total flow of water through the Strait of Florida. Considering water of a salinity of more than 34.65 per mille as Pacific deep water, one finds that more than one third of the water which flows through the Drake Passage is of this type, and it is evident that such a tremendous inflow of Pacific deep water to the Atlantic must have an appreciable influence on the character of the water masses in the southern part of the western Atlantic. There it is met with as an intermediate layer between the light surface water and the heavy Antarctic Bottom water.

In conclusion, it is of interest to consider the circulation of the Southern Ocean as a whole. All around the antarctic continent there exists one continuous current, flowing from west to east. Within the upper layer of this current one can

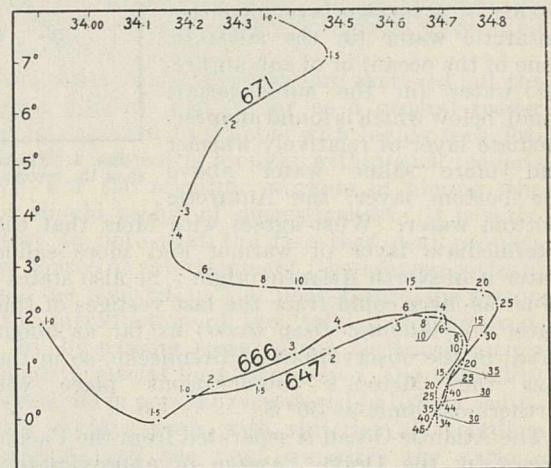


FIG. 3. Diagram of the relation of temperature and salinity for Stations 647 ($59^{\circ} 29\frac{1}{2}'$ S., $58^{\circ} 39\frac{1}{2}'$ W.), 666 ($49^{\circ} 58\frac{1}{2}'$ S., $29^{\circ} 52\frac{1}{2}'$ W.), 671 ($43^{\circ} 08'$ S., $30^{\circ} 15\frac{1}{2}'$ W.). The numbers alongside the curves represent the depths of the observations in hectometres.

discriminate between two typically different water masses, the antarctic water, and the sub-antarctic water of the west wind drift. These two water masses are separated by a boundary surface which

at sea level is recognized as the line of Antarctic Convergence. To the south of the broad easterly current a series of whirls are probably formed. These circular movements, of which the greatest is found in the Weddell Sea, are stationary and dependent upon the topographic features of the bottom of the sea, and of the coast line of the antarctic continent. In the regions of these whirls the places have to be sought where the Antarctic Bottom water is formed. To the north of the easterly current one finds the sub-Tropical Convergence representing the boundary between the warm and saline water from the Atlantic or Indian Oceans and the sub-antarctic water. Along this boundary surface, whirls are probably also developed, but these are not stationary but represent travelling disturbances which uphold processes of mixing. Through this mixing, the character of the

eastward-flowing water slowly changes. The water in 65° S. and approximately 28° W., which Merz and Wüst have considered as being of Atlantic origin, belongs according to our view to the great whirl of the Weddell Sea, which, however, represents a closed system to the south of the current from the Pacific, and therefore the warm and saline intermediate water of the Weddell Sea is for the most part of Pacific and not of Atlantic origin. The so-called Indian Ocean intermediate warm and saline water found in the southern part of the Weddell Sea is no doubt typical water of the circumpolar system.

I have had the advantage of discussing these results with Dr. H. U. Sverdrup, to whom I wish to express my grateful thanks.

¹ Defant, *Z. Gesell. Erdkunde*, Berlin, 1928.

² Wüst, *ibid.*, p. 506, *et seq.*

Helium Liquefaction Plant at the Clarendon Laboratory, Oxford

By Prof. F. A. LINDEMANN, F.R.S., and T. C. KEELEY

THE main properties of liquid helium have been familiar to men of science for a great many years. The only object therefore in liquefying it is in order to cool other substances the characteristics of which it is desired to study in the neighbourhood of the absolute zero. It has long been known that the heat capacity of solids becomes extremely small at low temperatures. Thus the latent heat of evaporation of 20 mgm. of liquid helium is sufficient to cool 60 gm. of copper from the temperature to be attained with liquid hydrogen boiling under a reduced pressure to the boiling point of helium.

It is easy to design apparatus so that the substances the properties of which at low temperatures are under investigation, are cooled to the temperature of the surrounding liquid or solid helium and maintained at this temperature with a minimum of waste. It seemed preferable, therefore, to instal a small inexpensive apparatus requiring comparatively little liquid hydrogen, which can therefore be operated frequently or duplicated at comparatively small cost, rather than to indulge in a plant designed to produce liquid helium in large quantities. In any event, the financial resources available would have imposed this choice, even had the alternative procedure been considered desirable.

The apparatus which has been installed at Oxford is of a type developed by Prof. Simon and Dr. Mendelssohn in Berlin and Breslau. Two concentric cylinders capable of withstanding a pressure of some 150 atmospheres surround the space in which the substance under investigation is placed. Helium under a pressure of about 100 atmospheres is introduced into the space between the cylinders. The upper part of the annular space between the cylinders is separated from the lower, in which the helium is compressed, by a metal sheet, thus forming a small metal container

which is joined by a spiral of thin copper tubing to a source of pure hydrogen. The whole is held in position on a German silver tube in the centre of a larger metal vessel containing hydrogen or helium gas at low pressure which can be evacuated by means of a mercury vapour pump. This outer vessel together with the copper spirals through which the hydrogen and helium are introduced is immersed in a Dewar flask containing liquid hydrogen.

When temperature equilibrium has been attained, hydrogen is introduced into the top vessel under a pressure of two or three atmospheres. Passing through the copper spirals, this liquefies owing to the excess pressure and runs down into the metal container over the double-walled helium cylinder. A tap to the mercury vapour pump is now turned on and a high vacuum produced in the metal box, so that the helium container with its superposed pot of liquid hydrogen is thermally insulated save for the necessary connecting tubes.

The yield of liquid helium is improved if the compressed helium is further cooled by boiling the hydrogen in the inner container under reduced pressure. If the helium is now allowed to expand, about half of it liquefies and the central space with the experimental substances it contains is cooled to the temperature of the surrounding helium. By evacuating the space above the liquid, that is, causing it to boil under reduced pressure, one can, of course, reduce the temperature to within one or two degrees of the absolute zero.

In the apparatus used at Oxford the helium lasts for about an hour and a half. If the experiment is not finished in this time, one can repeat the process in a few minutes at very small cost in liquid hydrogen. The helium expands into a rubber bag and is recompressed into a cylinder so that very little gas is lost. The temperature during the experiment can be observed on a large-

scale manometer connected through a fine tube to a small vessel containing helium in the liquefaction space. The apparatus cost approximately £30. Since there is no need to recompress the helium rapidly, a small cheap compressor is sufficient.

The liquid hydrogen required is produced in a plant of the standard pattern designed in the Physico-Chemical Institute in Berlin which has been in use at Oxford for some years now without giving any trouble. Impurities in the hydrogen are condensed by a preliminary expansion and continuously removed by a slow stream of hydrogen. With a compressor capable of dealing with ten cubic metres of free gas an hour and an expenditure of approximately 1.4 litres of liquid nitrogen per litre of liquid hydrogen, this plant produces some $2\frac{1}{2}$ litres of liquid hydrogen per hour. Liquefier and compressor together cost approximately £350.

The liquid hydrogen is stored in pyrex Dewar flasks silvered and exhausted in the laboratory. As their efficiency equalled that claimed for the

more complicated double vessels developed by Prof. Kapitza, they have been retained.

If low temperature work expands and a large number of experiments are in hand simultaneously, it may be necessary to consider the use of the continuous Linde process of liquefaction. In view of the cost of the gas and the precautions necessary for its recovery, its distribution involves considerable inconvenience, which for the time being are scarcely worth facing. The mere liquefaction, of course, offers no difficulties and there is little doubt that the Berlin type of apparatus, which is already in use in many laboratories, will prove as serviceable and efficient as the hydrogen liquefier, should it ever be necessary to change over to this system.

Finally, a word of thanks is due to Dr. Mendelssohn, who kindly brought the liquefier over from Breslau and placed all his knowledge and experience unreservedly at the disposal of the department. But for this, it would scarcely have been possible to obtain, without hitch or trouble, liquid helium within one week of the arrival of the apparatus in Oxford.

Metrology by Light Waves at the National Physical Laboratory*

IN 1923 the International Committee of Weights and Measures accepted the eventual use of a wave-length of light as the ultimate standard of length. Already in the previous year the Board of Trade had recognised the need of replacing the existing Imperial standard yard by a standard more in accord with modern requirements. For these reasons it was decided that the National Physical Laboratory should establish means of realising a wave-length standard of length and with it determine the length of the Imperial standard yard in terms of that wave-length.

The paper cited below, by Messrs. J. E. Sears, Jr., and H. Barrell, gives an account of the apparatus and methods which complete the first stage of this programme.

The new apparatus is of the type used by Benoît, Fabry and Perot, but is distinguished from the two previously existing instruments of this type in very many features of design. The more important new characteristics of the apparatus result from two radical departures from what was aimed at in the earlier instruments.

In the first place, Benoît, Fabry and Perot compared their optically determined metre etalon with a line standard by the usual methods of microscope observations, with the aid of fine lines scribed on the polished edges of the terminal glass plates of the metre etalon; the prototype metre being a line standard, such procedure was unavoidable at some stage of the work. In contradistinction to this, the apparatus at the National Physical Laboratory derives the length of an end standard directly from the length of the metre

etalon by optical interference, the ends of the etalon being polished parallel to a high optical precision by the Pitter Gauge and Precision Tool Co. of Woolwich by a technique worked out at the Laboratory in 1920. This procedure avoids one of the most difficult steps in the earlier work—the correlation of the positions of the reflecting surfaces of the metre etalon with those of the graduation lines.

Secondly, the new apparatus is so designed that measurements may be made either in air under controlled conditions, or in vacuum, and it thus makes possible new determinations of the refractive index of the air under various atmospheric conditions, which in any event will be needed before a wave-length definition of unit of length can be finally adopted for measurements of the highest precision. Measurements of this kind involve the observation of such variable factors as temperature, barometric pressure, humidity and possibly even carbon dioxide content of the air, and there are disagreements among the published values of the effects of these factors on the refractive index of the air.

It may be also noted here that the separation of the plates in the etalon which is used for the initial measurement has been increased from the $1/16$ m. used in the two earlier instruments to $1/12$ m., thereby leading to a greater relative accuracy in the basic measurement.

Although the above-mentioned new features of design are in principle the most important, those interested in the design of instruments will perhaps derive most pleasure in considering other details. The apparatus is characterised by a full envisagement of what functions were to be carried out and an adequate provision of means for their convenient

* "A New Apparatus for Determining the Relationship Between Wave-Lengths of Light and the Fundamental Standards of Length", by J. E. Sears and H. Barrell, *Phil. Trans. Roy. Soc., A*, vol. 231, pp. 75-145. Sept. 16, 1932.

and certain execution: one gets the impression that in using the apparatus there will be no need for successive trials in order that an essential adjustment or observation may be secured. Two examples of this must suffice.

One of the difficulties in the construction of etalons for such an apparatus is in securing that the lengths are exact multiples of the shortest one. Instead of relying on trial and error polishing of the ends, the etalons at the National Physical Laboratory are adjusted by four strain wires symmetrically disposed around the etalon, by means of which changes in length of any etalon of so much as 1 part of 25,000 can with certainty be produced without exceeding the elastic limit of the strain wires.

Again, not only must the supporting mechanism of the longest etalon be capable of the very accurate parallel displacements which are necessary, but such displacements must also be made with certainty and convenience and without varying the distribution of load on the supporting pillar and so forth. The means whereby this manipulation is secured are worthy of special attention.

It is a matter for great satisfaction that the Board of Trade together with the National Physical Laboratory decided to place metrology in the British Empire on a wave-length basis; and the designers and the workshop personnel of the National Physical Laboratory are to be congratulated on the successful completion of the first part of the programme.

Obituary

LIEUT.-COL. J. STEPHENSON, C.I.E., F.R.S.

WE regret to announce the death, which occurred in London on February 2, of Lieut.-Col. John Stephenson. He was born in 1871 at Padiham, Lancashire, and was educated at the Burnley Grammar School and the University of Manchester, where he had a distinguished career as a student in science and in medicine. After graduating, he acted as house-surgeon in the Manchester Royal Infirmary and in the London Hospital for Diseases of the Chest. In 1895 he was appointed to the Indian Medical Service and for the next five years was on military duty, including service in the North West Frontier Expedition of 1897. During the following years he was on plague duty and held various appointments as civil surgeon in the Punjab until in 1906 he became professor of biology in Government College, Lahore, of which he was appointed principal in 1912.

In Manchester, Stephenson had studied zoology for two years under the stimulating influence of Prof. Milnes Marshall, and with this foundation he instituted in Lahore instruction in the subject which reached a high standard and within a few years resulted in a productive school of zoology. Several of the students from his laboratories, whom he inspired with his own ideals of critical work and with the need for the investigation of the fauna of their country, are now holding influential zoological posts in India and have published important papers on their researches. His tenure of office in Lahore was marked by conspicuous success as a teacher and by high administrative qualities, and his quiet, effective personality left a deep and lasting impression on his students.

Stephenson resigned his post in Lahore in 1920 and I was fortunate in being able to attract him to the University of Edinburgh, in which he was appointed lecturer in zoology, to share in conducting the courses on invertebrates for senior students. His teaching was clear and concise, with a wide scientific outlook, and he was unsparing in giving

help and encouragement, especially to those who were reading for honours in zoology. In Lahore, immediately after taking up his duties, Stephenson began investigations on the aquatic oligochætes of the Punjab and during the next ten years published a series of papers on these worms. His interests then widened to the oligochætes in general and he examined numerous collections from various parts of India. These studies were continued with great assiduity in Edinburgh and in 1923 he published the important volume on the oligochætes in "The Fauna of British India" and became recognised as one of the two chief authorities on the order. Before he resigned his lectureship in Edinburgh in 1929, he completed the masterly monograph on the Oligochæta which was published early in 1930 by the Clarendon Press. Stephenson's mastery of the structure and classification of oligochætes, his extensive knowledge of the literature and his flair for conciseness and clearness in presenting facts and conclusions, enabled him to produce a monograph of exceptional merit which contains also conclusions of general interest; for example, on the bearing of the known facts of geographical distribution on the former existence of a more extensive antarctic continent and of Indo-Australian and other land-bridges, on convergence and on polyphyly. Stephenson was appointed in 1928 editor of "The Fauna of British India" in succession to the late Sir Arthur Shiple.

On leaving Edinburgh in November, 1929, Stephenson went to reside in London and continued his investigations on oligochætes as an unofficial worker in the Natural History Museum until about two months ago. Two years ago he became zoological secretary of the Linnean Society and took an active part in its affairs.

Stephenson was the author during the last twenty-seven years of numerous papers on Oligochæta. His contributions to the advancement of knowledge were recognised by the award in 1920 of the Keith Medal of the Royal Society of

Edinburgh and by his election in 1930 as a fellow of the Royal Society of London.

Stephenson regarded as a recreation his studies, which were carried out with his usual thoroughness and care, in Persian and Arabic history and literature. He published the text, with translation, and with commentary or annotations, of two works, the second of which (Royal Asiatic Society, 1928), the zoological section of the *Nuzhatu-l-Qulūb* ("Heart's Delight") was compiled by a Persian author about the year 1340 and gave a conspectus of zoological science of the time.

Col. Stephenson was held in high esteem as a sincere and loyal friend, for his sound judgment and for his readiness to help in all matters relating to the advancement of zoology in Great Britain and in India. His many friends will feel a deep sense of personal bereavement and will extend their sincere sympathy to Mrs. Stephenson.

J. H. ASHWORTH.

DR. JOHN THOMAS

JOHN THOMAS was born at Harlech in 1886 and died at his home at Wilmslow, Cheshire, on January 18, 1933. He obtained a scholarship at Barmouth County School as a boy and afterwards became a science student at University College, Aberystwyth; he entered at Trinity College, Cambridge, in 1908 with an 1851 Exhibition and, after taking his degree in 1910, was awarded a post-graduate research exhibition by the College.

Thomas soon showed notable talents as an organic chemist and published several papers on this subject while at Aberystwyth and Cambridge. In 1911 he joined the aeronautical section of the National Physical Laboratory as a research chemist and in the following year took up a similar position on the staff of the Nobel Explosives Co. at Ardeer. While at Ardeer he distinguished himself by investigations on novel and delicate explosive compounds which came into prominence during the War; his original experimental work on these and other subjects gained for him the degree of D.Sc. of the University of Wales.

In 1918, Thomas became chief chemist to the Solvay Dyes Co. which had just been founded by Mr. James Morton at Carlisle for the manufacture of fast dyes of the indanthrone group; these important essentials of the textile industry had not previously been made on a technical scale in Great Britain. When the original company was reconstituted as Scottish Dyes, Ltd., Thomas was appointed a director and soon after, in 1923, became the managing director. The manufacture of the fast vat dyes involved the translation of a delicate laboratory technique into large scale practise and for this work Thomas, as a skilful experimenter gifted with marked originality and breadth of view, was eminently suited. During the succeeding years, Thomas's name was attached to numerous patents for the preparation of new and improved vat colours and, as a result, the great works which Dr. Morton established at

Grangemouth on the Firth of Forth, now competes on equal terms with the German and Swiss producers of vat dyes. Scottish Dyes, Ltd., was absorbed by the British Dyestuffs Corporation and Imperial Chemical Industries, Ltd., in 1926; in due course, Thomas became joint managing director of the Dyestuffs Group of the latter organisation and held this position until the end.

Thomas was a master of his subject and combined with his experimental genius a fertility in expedient and an aptitude for organisation which are altogether rare; he was a happy and charming personality and a delightful companion. By his untimely death at the age of forty-six years the chemical industry has lost an outstanding figure and many of us have lost a very dear friend.

W. J. P.

MR. C. M. STUART

CHARLES MADDOCK STUART was a member of a large family with a remarkable record of strenuous endeavour combined with religious fervour and a roving disposition; one of his brothers was Canon of Canterbury, the recently deceased Dean of Carlisle was another; the late James Stuart, so well known at Cambridge, founder of the Mechanical School now the School of Engineering, was their cousin. I have briefly set out the family history, in an article in the February number of the *Journal of Education*, as an outstanding example of family heredity.

Stuart was born on September 25, 1857; he died on November 22, 1932. He was educated at Harrow and then entered St. John's College, Cambridge, of which later on he was a fellow. He paid attention chiefly to chemistry and took a first in the Natural Science Tripos in 1880. He next studied with Fittig at Strasbourg. Returning to England, he was first a master at Clifton College, afterwards at Newcastle-under-Lyne under Kitchener; finally, in 1888, he became head-master of St. Dunstan's College, Catford, S.E., then opened as a new school. He thus came into my neighbourhood and we were close friends from the beginning up to his death. My four sons were educated at the school. Prof. Andrade was one of his pupils; Oscar Faber, the engineer-architect of the new buildings of the Bank of England, was another; Mees and Sheppard, of photographic note, in connexion with the Kodak Co., were also trained at the school. The numbers rapidly rose to five hundred and the school soon became far the best in the Metropolitan area, probably in the country.

He was a keen mountaineer and a man of great physical vigour, as much at home with his boys at cricket and lacrosse as in the class rooms. He was an experimentalist from the beginning, greatly influenced by the exact training he had from Fittig. He is the only head-master I have known who acted as master of method throughout his school: every subject gained through his inspiration. His desire was to make his school suit

modern needs. Had the material at his disposal been of a higher mentality, he might have achieved startling results. In a brief note in the *Times* (Nov. 28, 1932) I have ranked him above Sanderson of Oundle, who was trained as a theologian and as an engineer and first became known at the nearby school, Dulwich College, where he established an engineering department, the first of its kind. Comparing the manual work in the two schools, St. Dunstan's was undoubtedly the better, without show and really disciplinary. Sanderson soon became a visionary and cultivated the spectacular: Stuart was to remain a reticent, unassuming Scot; he was almost a Cromwellian puritan in general outlook, without a trace of the cleric and yet a man of great moral force. He put his day school upon as high a moral and social level as that of any public boarding school: this was his great work. He believed in the sympathetic constructive inspector but hated examinations in every shape and form; he did not even accept them as necessary evils; he saw that they made all progress in methods of teaching impossible.

Schools of the type Stuart created are, I believe, the schools of the future. Men of his type will be the future head-masters, if they can be found and provided with proper assistance. Unfortunately we have not yet discovered how to maintain a school when once established—comes a new head and it at once changes. We will not learn from one another; only those who cannot lead will follow a leader.

H. E. A.

WE regret to announce the following deaths:

Prof. Eugen Bamberger, emeritus professor of general chemistry in the Technische Hochschule

at Zurich, who carried out numerous investigations, chiefly on aromatic and heterocyclic compounds, aged seventy-five years.

Dr. Alfred Eichholz, C.B.E., chief medical inspector, Board of Education, on February 6, aged sixty-three years.

Sir Frederic G. Hallett, O.B.E., formerly secretary of the Conjoint Examining Board of the Royal Colleges of Physicians and Surgeons, on February 5, aged seventy-two years.

Dr. H. Theodor Holm, known for his work on arctic botany and on plant anatomy, on December 26, aged seventy-eight years.

Prof. E. H. Moore, emeritus professor of mathematics of the University of Chicago, president in 1921 of Section A of the American Association, who was known for his work on the theory of numbers, on December 30, aged seventy years.

Prof. A. H. Sayce, formerly professor of Assyriology in the University of Oxford, on February 4, aged eighty-seven years.

Prof. Alfred Schaarschmidt, president of the Institute of Chemical Technology at the Technische Hochschule, Charlottenburg, who was specially interested in problems of nitration, aged forty-nine years.

Sir William Taylor, K.B.E., regius professor of surgery at Trinity College, Dublin, president of the Royal Academy of Medicine, Ireland, since 1927 and president of the Royal College of Surgeons, Ireland, in 1916, on January 29, aged sixty-one years.

News and Views

Award of the Duddell Medal of the Physical Society

THE council of the Physical Society has awarded the tenth Duddell medal to Prof. Wolfgang Gaede, director of the Physical Institute at Karlsruhe, and until recently professor of physics at the Technische Hochschule there. Prof. Gaede's name will always be associated with the design and production of high vacuum pumps. Before 1905 the production of a vacuum beyond that attainable with a filter pump or piston pump was a tedious operation, carried out almost always with a mercury pump of the Toepler or Sprengel type. The remarkable thing about Gaede's investigations is not merely that at the age of twenty-seven he designed a rotary mercury pump which was simple, easy to work, and marked a great advance, but also that since then he has produced at intervals a number of vacuum pumps, each with a definite field of utility, and some of which are based on wholly new principles developed largely by Gaede himself. Thus the rotary mercury pump of 1905 (for many years the pump chiefly used in electric lamp manufacture) and the rotary oil pump of 1907 were followed in 1913 by the rotary box pump used as a

backing pump for high vacuum pumps, and by the molecular air pump, which was the first of the really high-speed pumps. In 1915 came the mercury vapour diffusion pump, the forerunner of nearly all the high-speed vacuum pumps used to-day, whether employing oil or mercury vapour. Within the last ten years, Gaede has designed a family of pumps of several stages, incorporating both the high-vacuum and the fore-vacuum pump into a single unit. A recent outstanding development was the large single-stage diffusion pump designed by Gaede for work at Leyden on solid helium. This had the remarkable speed of several hundred litres per second at a pressure of 1/1000 mm. mercury.

White and Black in Africa

SOME essential factors in the problems affecting the future of the white and black races in Africa were indicated by Mr. Frank H. Melland, formerly of the administrative service of Northern Rhodesia, in a lecture on "Witchcraft in Africa" before the African Society on January 31, at which Lord Buxton was in the chair. Mr. Melland pointed out

that while the native visits the white man on a friendly basis and brings certain of his troubles to him, this does not apply to witchcraft, because the white man does not believe in it. The problem is to teach the black man to think 'white', just as we ourselves in many parts of Africa are trying to think 'black'. Hence Mr. Melland stressed the value as an educative influence of carefully selected films of British life which should be brought before the native. While it is perfectly obvious that as the conditions of life and hygiene in tropical Africa become better understood, the number of white settlers will increase, it is frequently overlooked that the black man is equally a permanent element in the future situation which must be taken into account. As Mr. Melland pointed out, he will not disappear as the red man in America or the Australian blackfellow have disappeared, nor will he survive as an historical curiosity. The Bantu are the most virile and persistent racial stock extant, and they outnumber the white man in the highlands of Africa by fourteen to one. Lord Buxton, judging from his own experience, thinks that the belief in witchcraft is by no means so strong as it was some years ago; but taking this as symptomatic of advance in other directions, progress must be slow. If it were not for difficulties of which there has been abundant evidence recently, it would seem scarcely necessary to urge the necessity for the scientific study of native ways of thought and institutions to ensure that progress in native development is in a direction which will permit of the two races living side by side in one community, as forecast by Mr. Melland.

Aims of Anthropological Research

PROF. FRANZ BOAS of Columbia University, in his presidential address to the American Association for the Advancement of Science at the meeting at Atlantic City in December last, made a survey of present-day methods of approach in anthropological research, which was remarkable not only for the thoroughness with which it traversed the ground, but also for the critical acumen which probed weak spots in the theories dominant at the moment in the various schools of thought. He suggested caution in estimating the possibilities of formulating general laws. His final conclusion is that the study of 'foreign cultures' should enable us to see how many of our lines of behaviour, that we believe to be founded deep in human nature, are actually expressions of our culture and subject to modification with changing culture. "By a study of the universality and variety of cultures," he said, "anthropology may help us to shape the future course of mankind." Prof. Boas, holding that the objective of anthropology is the attempt to understand the steps by which man has come to be what he is biologically, psychologically and culturally, also holds that its material must be historical in the widest sense of the term, and that in the argument for diffusion it is not a safe method to assume that all analogous cultural phenomena must be related. "It is necessary," he says, "to demand in every case proof of the historical relation,

which should be the more rigid the less evidence there is of actual recent or early contact." Prof. Boas's address appears in full in *Science* for December 30, pp. 605-613.

Dr. John Roebuck, F.R.S., 1718-94

WE learn with interest that the tomb of Dr. J. Roebuck, one of the founders of the famous Carron Iron Works, Falkirk, has recently been restored. Roebuck was born in Sheffield in 1718 and after studying in Edinburgh took the degree of M.D. at Leyden. Returning home, he practised in Birmingham, but, becoming interested in practical chemistry, he was successful in introducing the use of lead chambers into the manufacture of sulphuric acid. In 1759, with Samuel Garbett and William Cadell, he founded the Carron Company, the first concern in Scotland to use coal for smelting iron and the first to use ironstone from the carboniferous formation of central Scotland. Roebuck was the friend of Watt, Boulton, Smeaton and Black, and was a fellow of the Royal Societies of London and Edinburgh. He died in July 1794 at Bo'ness, near Grangemouth, and was buried in Carriden churchyard. His grave is surrounded by a low wall while at the head of it is a marble tablet bearing a long inscription in Greek and Latin, referring to his studies in chemistry and metallurgy, which sciences "he expounded and adapted to human needs with a wonderful fertility of genius and a high degree of painstaking labour". The restoration of the tomb has been carried out by the descendants of Dr. Roebuck and the Carron Company. The Company, it may be added, has published an interesting series of leaflets recalling some of the famous men who have been associated with the works.

Lancaster Frankland Society

AT a meeting held in the Storey Institute, Lancaster, on January 18—the anniversary of the birth of Sir Edward Frankland in 1825—a proposal was brought forward to form a society in Lancaster to perpetuate the memory of this great chemist. Prof. H. E. Armstrong, Frankland's oldest living pupil, in the course of an interesting address, reported in the *Lancaster Observer* of January 20, lent his support to the proposal. Frankland, he said, went to Lancaster at a very early age and remained until 1845, attending first a private school and afterwards the Royal Grammar School; a valuable part of his training was obtained also during his apprenticeship in a local druggist's shop, for there he learnt to use his hands. Prof. Armstrong expressed the hope that the founders of the organisation would remember Frankland not only as a chemist but also as a man of wide attainments, and that besides chemists they would include botanists, geologists, and particularly sanitarians—for Frankland's important work in giving Great Britain a pure water supply lay in association with sanitary science. In supporting the proposal, Dr. Shackleton Bailey mentioned various past pupils of the Royal Grammar School, Lancaster, who have achieved eminence in science, among them

being Sir Edward Frankland in chemistry, Sir Richard Owen in biology, Prof. Seward in botany, and Prof. Marr in geology. A letter of support was read from Prof. P. F. Frankland. Prof. Armstrong is to be president of the new society, which, it has been decided, shall be called the Lancaster Frankland Chemical Society.

Biology's Message for Civilisation

IN an address to Sections D and F of the South African Association for the Advancement of Science in July 1932, Prof. H. B. Fantham, recently elected to the chair of zoology in McGill University, Montreal, essayed to interpret biology's message for the plight of modern civilisation (*South African J. Sci.*, vol. 29, p. 533). Prof. Fantham regards the expenditure on education as excessive, and the subjects taught too many; his own ideal list includes general elementary science (including biology), the languages of the country, reading, writing, arithmetic, economic and human geography, history, some cultural subject like singing, needlework and cookery for girls, drawing and woodwork for boys, moral principles, and perhaps simple drill, anything beyond these to be paid for by the parents concerned. Elementary education alone should be free, for so-called free education is 'free' only to the parents directly concerned and not to the community. The mechanisation of the modern world is a disharmony, which is narrowing and starving human life. Doles are "perhaps the greatest biological mistake in the social organisation of the present age"; relief should be made conditional on the giving of service. Generally, Prof. Fantham holds that there is too much administration, too much organisation, too many conferences and too much mechanisation, so that man's environment has become too artificial, and the result of the disharmony is expressed in instability and unrest. Some suggestions made by the author are that government must be by paid business managers trained in science and administration; that production must be adjusted to demand and the scientific organisation of distribution; that wages should be judged by their purchasing power; that the movement back to the land should be encouraged; that wars should cease and war debts be cancelled; and that eugenic measures should be employed to cope with problems of over-population.

The Language Difficulty and Scientific Progress

DURING the course of a year we receive many journals, reports of congresses, and papers printed in languages which, it must be admitted, are unfamiliar to the majority of scientific workers and sometimes in alphabets which add to the difficulties of interpretation. Fortunately, the custom is growing of adding to each paper a summary of its contents in English, French or German, but no summary can ever replace, for a scientific worker, the detail of the method and observations of the paper summarised. The relegating to comparative obscurity, on account of the language difficulty, of many papers of value is all against the progress of scientific know-

ledge, and it is for that reason that we venture to appeal again for an increased use, if not in whole at least in summary, of the languages which have come to be recognised as the general vehicle of scientific researches. The tendency of recent times was the subject of discussion at the fifteenth annual meeting of the American Society of Ichthyologists and Herpetologists in Washington, D.C., in May 1932, and the following resolution was passed unanimously: "Whereas, a large number of ichthyologists and herpetologists of countries using non-Latin alphabets are publishing their papers in the English language; therefore, be it resolved that the American ichthyologists and herpetologists, through their Society, desire to thank their fellow scientists of other lands for publishing in English."

Use of the English Language

AT the Friday evening discourse at the Royal Institution on February 3, Dr. Cyril Norwood discussed the use of the English language. Dr. Norwood directed attention to the particular dangers to present-day writers arising from the rapid wear and tear of words and phrases, and the decay of metaphors, and pointed out that these arise from, among other things, the excessive use of technical language which reduces words to a system of symbols. Illustrations from the works of leader writers and of men of science were given to show the kinds of error which are very frequent, and to illustrate methods of style which delay the reader's apprehension and defeat the writer's object. The methods of Darwin, who was without natural gifts of style, but took infinite pains to render his writing clear and attractive, were examined and Dr. Norwood suggested that Darwin's example could well be followed. A similar study of Huxley was made, and Dr. Norwood quoted a passage from his writings which he considers is a model of written English.

Economic Value of Agricultural Science

THERE must be few engaged in research who have not been called upon to justify the policy of scientific examination of technical problems in face of the apathy or distrust of the practical man. This is particularly so in the case of agriculture, in which it is still possible to continue by the use of traditional methods. Fortunately, the list of scientific achievements which have given the cultivator vastly greater command over the forces of Nature is a long one; and the critic may be made to realise that practically the whole agricultural technique that was not possessed by his grandfather is the direct outcome of scientific research. In an address delivered to the Wellington Philosophical Society on October 26, Lord Bledisloe, Governor General of New Zealand, very ably sets out the economic value of agricultural science. Addressing his remarks to the primary producer, Lord Bledisloe points out that only by fostering scientific research and applying its results to practice can a place be maintained in world markets, continually more congested and more exacting

in their requirements. Research, however, must be thorough, tested out in all its bearings, and put before farmers as a sound investment. Surveying the whole agricultural field, the leading achievements of agricultural research which have led to definite economic results are touched on, and even to those familiar with the subject the cumulative result is impressive. The problem of production has been solved. The famines predicted from time to time in the recent past are not likely to trouble us. The need for the future is to get into wider circulation the plenty which improved methods have secured.

Gold and Silver Currencies

IN a recent publication ("Standard Gold' and Silver: the Way out of the Crisis." Pp. 88. Manchester: Taylor Garnett Evans and Co., Ltd., 1932), Dr. Ernest Zucker advocates the devaluation of the world's gold currencies by means of a one-third reduction in the gold content of the standard coins. He also advocates the introduction of silver as a subsidiary currency to facilitate trade with the silver-using East. The effect of the first proposal, he argues, would be to raise the prices of raw materials and similar commodities by about half, since their prices are world prices based on gold. The purchasing power of wages and salaries, on the other hand, would be reduced by about a third. In this way the disequilibrium between the prices of raw materials and manufactured products could be removed, while inter-allied debts and reparations would be reduced by a third. Dr. Zucker's scheme, however, presents serious difficulties. First there is the practical problem of securing common action among creditor nations, especially the United States and France. Secondly, devaluation would not in itself re-adjust the maldistribution of gold. Creditor countries would continue to attract the world's gold and if they persisted in high tariff policies, it would still be difficult for debtor countries to make payments, or for the volume of world trade to be increased.

Daily Mail Ideal Home Exhibition

THE *Daily Mail* Ideal Home Exhibition will be open at Olympia, London, W., on March 29–April 29. According to advance information recent developments in illumination will be utilised to create in the Grand Hall of Olympia, a 'Rainbow City'. The colours of a great rainbow, appearing from among 'clouds of depression', will be produced by a gigantic scheme of neon lighting, and the eye will travel back over a hall in rainbow hues to 'the sun of prosperity'. Scientific workers will be attracted by a series of "Rooms of the Scientists" on the first floor of the Empire Hall, where we are promised representations of the surroundings in which Newton, Faraday, Marconi and others carried on their investigations. A section of the Exhibition will be devoted to the home cinema, while close by will be the telephone exhibit of the General Post Office. Modern sanitation, heating and refrigeration apparatus, lighting schemes, general house equipment and labour-saving devices

—indeed, everything for home service, comfort and recreation—are other and more usual features of the annual exhibition.

Land Utilisation Maps

THE Land Utilisation Survey has produced through the Ordnance Survey two one-inch sheets embodying some results of its work. These are sheets 114, covering the area to the south-west of London, and 142, showing the Isle of Wight, Portsmouth and the southern part of the New Forest. They are published at 4s. each and the sheet lines are the same as those of the popular 'one-inch' maps. Results are reduced from the original 'six-inch' survey and printed in six colours over the topographical detail and contours of the original Ordnance sheets—on which the rivers appear in blue. Dark green shows forest and woodland, light green meadowland and permanent pasture, brown arable or tilled land, including grass grown in rotation and land lying fallow at the time of survey, yellow heathland, moorland, common and rough hill pasture and purple garden allotments and orchards. Land that is agriculturally unproductive, including built-over land, quarries, yards and roads is shown in red. Private parks and golf courses have been divided according to the use made of the land for grazing or other purposes. The maps are beautifully produced and give a striking picture of the uses to which land in Great Britain is put and should prove invaluable for many purposes. It is hoped to publish further sheets in course of time.

Dried Poultry Manure

THE possibility of making better use of poultry manure is receiving considerable attention at the present time and in the *Journal of the Ministry of Agriculture* (vol. 39, p. 656) R. Sayce and F. Hanley give an interesting account of the production of kiln-dried poultry manure. The kiln, which is very similar to that used in maltings, is a ventilated brick building with a corrugated asbestos roof which is lined with asbestos sheeting. It is heated with an ordinary coke furnace and a system of flues. After a preliminary drying in the air for about two days, the manure is spread on the kiln floor to a depth of 7–8 in., being turned occasionally during treatment. The time required for the drying process depends on the state of the material, its depth on the floor, weather and other conditions, but 48 hours should be sufficient for average material 6–7 in. deep, the maximum temperature during the process usually approaching 300° F. Four tons of manure may conveniently be treated at a time and will yield approximately two tons of dried material, which should not contain more than 7–10 per cent moisture if it is to store satisfactorily. Some loss of nitrogen during the drying is unavoidable, but analyses show that the final composition of the poultry manure closely resembles that of other organic fertilisers, which sell at £3 10s.–£5 a ton, at present in considerable demand in market gardening districts. In addition, the constituents are present in a readily available form.

Forest Products Research in the United States

THE valuable research work which has been carried out at the Forest Products Laboratory of the United States Forest Service, which is situated at Madison, Wis., is well known. According to Science Service, Washington, D.C., many difficulties are encountered in seasoning wood, and a treatment is being sought which will prevent, or greatly reduce, shrinking and swelling, thus removing one of wood's principal disadvantages. Fire-retardant treatment is under investigation and several combinations of chemicals are said to give promise of practical results. Great improvements in the manufacture, preparation and use of glues have been made in the last decade. Experiments which are being undertaken appear to show that plastic compounds from chipped wood or pulp fibres have possibilities of competing with other products for panels, tiles, mouldings and other articles, a development which the lover of the genuine article will not regard with great pleasure. Some other problems awaiting solution are forecast by Mr. Arthur Koehler, the officer in charge of sylvicultural relations at the Forest Products Laboratory. For example, joints and joint fastenings, now the weakest part of wooden structures, require improvement. It is held that wood could be made more attractive by colouring with transparent dyes or treatment with gases, such as ammonia, increasing lustre by transparent coatings, or treatment of wood itself. On the subject of wood working machinery scientific study is required as, for example, the development of a planer which would leave no marks, thus eliminating sanding and raised grain troubles.

Meteorological Records of Southport

FEW towns possess such accurate and long meteorological records as Southport. This is largely due to the late Mr. Joseph Baxendell, whose work has been carried on and extended by his son, for many years meteorologist to the Southport Corporation. Each year's records are summarised and discussed in an annual report; the report for the year 1931 has recently been published. There is a number of tables in these reports which differ in form from any of those appearing in the annual summaries of the Meteorological Office, and these add greatly to the value of the series. Among them may be mentioned those showing rainfall with different wind directions, diurnal variation of the duration of sunshine (totals for each hour of the day for each month) and mean level of subsoil water. This last table is a particularly interesting one. It has been maintained for forty-nine years, first of all by the late Mr. J. Baxendell at a private house in Liverpool Road, Birkdale, and later at 34 Kent Road, Birkdale, by Mr. James France and his wife. The record unfortunately ends at the close of the year under review, but alongside the last set of monthly figures appears similar information for the recently established meteorological station at Bedford Road Park, which is in the same part of Southport. To those not very familiar with this subject these

single year's observations are not without interest, as they show differences of response to the meteorological conditions in spite of the proximity of the two wells used for making the measurements. June 1931 was very wet at Southport—5.99 inches of rain fell at Bedford Road Park—and the mean level of water in the shallower well at the older site rose in June almost to its February value, which was by no means the case at the other deeper well. The last six months of 1931 yielded altogether substantially more than the normal rainfall, but the average level of the shallower well almost returned to its normal value.

Electrification of the Swedish State Railways

THE primary object of electrifying the State railways in Sweden was to make them independent of foreign fuel. In 1920, when the project was first considered, the probable future price of locomotive coal was considered to be about £8 per ton. To make a more accurate estimate, local and English experts were consulted and they considered that the price would not fall below £2 15s. per ton. In spite of these estimates, the price of coal has continued to fall. In 1923 it was less than £2 per ton, it then fluctuated for several years about £1 per ton and it was only 16s. a ton in 1931. These fluctuations in the price of coal make it difficult to estimate the economy effected by electrification. At present, two sections of the Swedish State Railways are in electrical operation; the Ore railway in the north (280 route miles) and the Stockholm-Göteborg line (285 route miles). The electrification has increased the carrying capacity of the Ore railway by about fifty per cent and the average speed of the trains has been doubled. In a paper on the Swedish railways read to the Institution of Electrical Engineers on January 5, Mr. Öfverholm pointed out that the results on the Ore railway would have been more satisfactory if the existing station arrangements had been altered so as to allow longer trains to be employed. Considerable extensions of the system are being undertaken. By the end of the present year, 1,680 route miles of the State railways will be electrified. This corresponds to about forty per cent of the complete railway system. Several difficulties were experienced when electrification was first adopted. The disturbance on the telephone lines was obviated by suitably arranging the suspending wires of the power lines. By taking the power for the railway operation from the national distribution system, considerable economies were effected. The project of connecting the Swedish and Norwegian railways by a new bridge at Svinesund is being considered.

Andaman and Nicobar Islands

THE publication of the census report on the Andaman and Nicobar Islands (Census of India, 1931: vol. 2. Calcutta: Central Publication Branch; 7s. 6d.) has given an opportunity for the production of a valuable monograph on the aborigines of these islands, the cultural anthropology of the Nicobar natives and various reports on the forests,

agriculture and trade. Most of these reports are by Mr. C. J. Bonington, but several other writers have collaborated in the work. The Andaman population of 19,000 shows an increase, but this increase is solely in the convict and other immigrant population. The aborigines have fallen in number to 460 compared with 786 ten years ago, 1,317 in 1911, and nearly 5,000 when contact with an introduced population began in 1858. There seems to be little hope of these races surviving. On the other hand, in the Nicobars, where there has been little disturbance with the natives or their tribal systems, the aboriginal population shows a steady increase during the last thirty years and is now nearly 10,000. The figures in several of the islands are based on estimates but there is no reason to doubt their accuracy.

Sterility in Domesticated Animals

A USEFUL bulletin has been issued from the Imperial Bureau of Animal Genetics, Edinburgh, (2s. 6d.), on the physiological and genetical aspects of sterility in domesticated animals. It is written by Dr. William Orr and Dr. F. Fraser Darling, and a full bibliography, prepared by Miss M. V. Cytovich, is appended. Successive sections deal with physiological aberrations in the reproductive system, the nutritional aspects of sterility, and types of sterility referable to genetical causes. This will be of service not only to all those engaged in practical animal breeding but also to those engaged in research on the physiological or genetical aspects of animal sterility.

Centenary of Sir John Kirk

IN connexion with the centenary on December 19 of Sir John Kirk (see NATURE, 130, 920, Dec. 17, 1932), a portrait of Kirk was unveiled at the Zanzibar Museum, Zanzibar, by Sir Richard Rankine, British Resident for the Protectorate, in the presence of His Highness the Sultan. A number of exhibits associated with Sir John Kirk were displayed at the ceremony.

Effect of the Preying of Birds on Butterflies

MR. C. L. COLLENETTE writes from the Entomological Department, British Museum (Natural History), South Kensington, London, S.W.7, that he is making an investigation into the extent to which butterflies in the perfect or imaginal state are preyed upon in the British Isles by birds, and he would be glad to have any first-hand observations, giving, where possible, the species of both butterfly and bird, the date and locality, details of mode of capture, etc. Wings detached by the bird are of value, both as evidence of identity, and also by reason of the imprint of the bird's beak which is sometimes shown. Published records up to and including the year 1908 have been summarised in a paper by Sir Guy Marshall entitled, "Birds as a Factor in the Production of Mimetic Resemblances among Butterflies" (*Trans. Ent. Soc. Lond.*, 329-383, 1909). Mr. Collenette is making a search in both entomological and ornithological literature for British records published since this date, and he would be pleased to receive references especially in the lesser-known publications.

Announcements

A DISCUSSION on "The Raman Effect in Relation to Some Chemical Problems", to be opened by Dr. J. J. Fox, will be held at the Chemical Society on February 16, at 8 P.M.

DR. S. COURTAULD, a trustee of the National Gallery and founder of the Courtauld Institute of Art, Mr. E. G. V. Knox, editor of *Punch*, and Dr. N. V. Sidgwick, F.R.S., fellow of Lincoln College, Oxford, and member of the Advisory Council of Scientific and Industrial Research, have been elected members of the Athenæum under the provisions of Rule II of the Club, which empowers the annual election by the Committee of a certain number of persons of distinguished eminence in science, literature, the arts or for public service.

THE next sectional meeting of the World Power Conference will be held at Stockholm on June 28-July 4. Reference was made to the programme in connexion with this meeting in NATURE of January 7, p. 22. Forms of application for membership can be obtained from the British National Committee, World Power Conference, 63, Lincoln's Inn Fields, London, W.C.2.

THE following have been elected officers of the Royal Meteorological Society for 1933:—*President*: Prof. S. Chapman; *Hon. Treasurer*: Mr. R. A. Watson Watt; *Hon. Secretaries*: Dr. J. Glasspoole; Mr. W. M. Witchell, and Dr. A. Crichton Mitchell; *Foreign Secretary*: Capt. C. J. P. Cave; *New Members of Council*: Mr. J. H. Field, Dr. B. A. Keen, Capt. W. N. McClean, and Dr. F. J. W. Whipple.

THE Central Scientific Company of Chicago has issued the first two numbers of a bulletin entitled *Cenco News Chats* which is meant to furnish to the public interested in instruments an up-to-date account of new developments in apparatus for which the Company is responsible. It is less formal than a catalogue, is well illustrated and does not enter into scientific details. We learn from it that the Bunsen burner with an H base with side entrance for gas and bottom for air is the most popular, and that the wire gauze over the flame should be iron 16 mils in diameter and 16 to the inch. Spectra photographed by means of a Wallace concave grating replica with a ruled surface only 28 mm. by 20 mm. are reproduced, and a short account of the Hahn X-ray spectrograph is given. Copies of the *News Chats* may be obtained on request from Messrs. Edwards, Allendale Road, London, S.E.5.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A temporary inspector in the Markets Division of the Ministry of Agriculture and Fisheries—The Secretary, Ministry of Agriculture and Fisheries, 10, Whitehall Place, London, S.W.1 (Feb. 20). A principal and head master of the Maidstone Technical Institute and Junior Technical School—Mr. A. W. Peacock, Education Department, Tonbridge Road, Maidstone (Feb. 25).

Letters to the Editor

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

Origin of Curls and Twists in Wool Fibres

WILDMAN¹ has recently discussed the sequence of development of the fetal lamb's coat, showing early anterior to posterior and later secondary progressions in follicle initiation over the skin surface. He directs attention to the spiral shape of wool follicles and the changes in direction of the growing point as development proceeds, concluding therefrom that the shape of the fibre is largely determined by the shape of the basal portion of the follicle.

The prototrichs characteristic of the natal coat, as described by Duerden², exhibit all shapes of tip from sickle to fine curly, the form being apparently related to the kind of growth which proceeds. Thus a gradual increase of thickness (presumably with progressive enlargement of the follicle growing zone) leads to the 'sickle tip' condition, while curly tip is associated with a mere elongation of extruded fibre without change of cross-sectional area. Irregular waviness is then exhibited in each prototrich before fibre production 'settles down' to that of the definitive fibre more typical of the adult coat and in general of more regular growth; that is, until the follicle population assumes its normal adult activity, when the definitive fibre structures continue as spirals, waves or with helical twists. The work of S. G. Barker and his collaborators^{3,4} on 'crimp' apparently justifies the conclusion that a *straight* fleece fibre is extremely rare. The region of activity of the various forces imposing curl and twist upon the fibre must clearly lie within the lower parts of the follicle, although its characteristic shape may conceivably be modified by other forces, acting on the parts still surrounded by the follicle structure, such as varying rates and zones of dehydration (vide King and Nichols⁴). The direction of emergence of the fibre is generally not perpendicular to the skin surface and directional currents of fibre slope may be observed in many forms, though on the fleece areas they may be more or less obscured by the density of the fibre population, and, in the birth coat, by the tendency for groups of extruded fibres to approximate into the familiar lamb's coat 'spirals'.

The different forms of spirals (for example, horns in sheep) which result from larger accretionary growths have been discussed by Thompson⁵ and Huxley⁶ on mathematical premises based upon the existence of growth gradients about different axes of the growing region. A suggestion may be made that similar systems may operate within the comparatively restricted growth zones of hair follicles. It is conceivable that the forces within the follicle required to give rise to the various curved forms of fibre may follow upon different growth intensities (yielding different rates of elaboration of fibre substance) at different aspects of the follicle. Any asymmetry of the follicle growing zone could allow of differential rates of production of fibre constituents, while the disposition and orientation of the follicle in relation to the general growth gradients would affect the direction and magnitude of the forces at play.

Thus the form growth of the wool fibre would simulate in miniature that of the sheep's horn (omitting except in early stages the increase of cross-sectional area). The definitive fibre continues as a spiral, a uniplanar wave or with twist, whichever be the characteristic deformation associated with the type of follicle involved.

As a corollary to Thompson's studies of horn shapes and to the views here proposed, an explanation of the rarity of straight fibres in fleece growth seems possible. The essentials for a perfectly straight fibre would thus be symmetry of the basal portions of a follicle about a line perpendicular to the skin and the absence of differential intensity of growth. The follicle would have to be situated at a point of zero gradient, such as at the centre of a true hair whorl. These considerations would seem to render the production of a perfectly straight fibre extremely improbable.

J. E. NICHOLS.

Wool Industries Research Association,
Torridon,
Leeds.

¹ *Proc. Zoo. Soc.*, Pt. 2; 1932.

² *NATURE*, 130, 736, Nov. 12, 1932.

³ *vide* "Wool Quality", H.M. Stat. Office, 1931.

⁴ *Trans. Faraday Soc.*, 29, Pt. 1; 1933.

⁵ "Growth and Form", 1917.

⁶ "Problems of Relative Growth", 1932.

Further Mutations in the Amphipod *Gammarus chevreuxi*, Sexton

New developments in *Gammarus chevreuxi* have appeared in the course of some experimental work on the question of the origin of recessive characters, and how far they may be present in the wild.

During the past twenty years we have examined more than half a million of these *Gammarus* as they were brought in from the wild, but with regard to the black reticular pigment of the eye, so far not a single variant has been seen. We have, however, found more particularly in recent years that variations occur in the amount of the white superficial pigment.

In the laboratory¹ on the other hand a number of recessive mendelian characters have arisen, principally relating to the eye, though in one instance², the 'white-body' of Stock II, the body colour was also affected. Changes of colour, such as red, white, purple, took place in the pigment of the reticular cells, and in one mutation, the 'albino' of Stock I, the cells themselves were lacking. In several stocks 'nowhites' appeared, that is, animals with none of the superficial white pigment in their eyes.

A new departure among the recessive characters that have recently appeared is a *red-eye* with which is associated *nowhite*, the two characteristics, namely, complete lack of both black reticular pigment and white superficial pigment not having up to now segregated from one another. The original black pair gave a black F_1 brood of 12, which, intermated, produced an F_2 of 49 blacks and 12 of these red-with-nowhites.

This new stock is a very distinct one, as proved by cross-matings with recessives of nine other strains, whitebody, lilac, six other and different reds, and the red-nowhite of Stock I. The last mentioned mating, red-with-nowhite with Stock I red-nowhite gave, for the first time in the nowhite matings of this species, normal blacks, that is, black eyes with the white reticulation.

Another new mutation is the *lilac-eye*. In this the recessive eye when hatched is a pale clear lilac colour, with white reticulation, but as the animal grows the white reticulation practically vanishes, and the colour fades from the centres of the ommatidia to collect in thin dark rings around the cone-margins, giving the effect of an eye composed of creamy white circles set in black or brown network. This, too, is a simple mendelian recessive. A curious occurrence must be noted in the blacks of the F_3 and F_4 generations of this lilac stock. Five of the females, normal in body colour and in the dark green gonad colour, gave white eggs; seventeen batches of eggs were laid, but no young hatched.

The other interesting new features of the experiment are the reappearance of the white-body mutation in the F_3 of another stock, and the reappearance of the Stock II red-eye (1922) in no less than five of the new stocks, three in the F_2 generation from the wild, and two in the F_3 and F_4 .

Mated *inter se*, and with Stock II recessives, the results were as in Stock II, namely, red mated with red gave red; red ♀ mated with white II ♂ gave red; white II ♂ mated with red ♀ gave white young¹. But with regard to the behaviour of the red pigment there is a great difference. In Stock II the distinction at birth is clearly marked between a bright red-eye normal body colour, and a white-eye white-body, but in at least three of the new stocks, there is considerable variation in the red-eye colour though the body colour is always normal.

Even in the same brood, the eyes at birth may be bright red, different shades of pink, or cream colour; the reds may lighten to pink or even cream, and the cream develop redness, or they may change but little. At the extreme limit of the change, the eyes are white and indistinguishable from the Stock II 'flushed whites', that is, eyes white with a very faint tinge of colour in two or three central ommatidia, yet they always function as reds. Similar variation in the concentration of the red pigment has already been found in the r_2r_3 types of Stock V, and among the reds known as *Flesh*².

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A. R. CLARK.

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Jan. 11.

¹ Sexton, Clark and Spooner. "Some New Eye-colour Changes in *Gammarus chevreuxi*, Sexton." Pt. II. *J. Mar. Biol. Assoc.*, 18, 1; 1932.

² Sexton and Clark. "New Mutations in *Gammarus chevreuxi*, Sexton." *NATURE*, 117, 194, Feb. 6, 1926.

³ Sexton and Pantin. "Inheritance in *Gammarus chevreuxi*, Sexton." *NATURE*, 119, 119, Jan. 22, 1927.

⁴ Spooner. "An Experiment on Breeding Wild Pairs of *Gammarus chevreuxi*, etc." *J. Mar. Biol. Assoc.*, 18, 1; 1932.

Distribution of Molybdenum

I WOULD like to supplement Prof. H. ter Meulen's observations on the distribution of molybdenum in *Nature*¹ by repeating facts which so far have been published only in a preliminary report in a horticultural journal².

The character of an apple tree is profoundly influenced by the root system on which it is worked (budded or grafted); a particular variety may be rendered precocious or slow in fruiting, vigorous or dwarf in habit, resistant or susceptible to certain diseases, etc., by suitable choice of the rootstock on which it is worked. So far, it has not proved possible

to imitate all these groups of effects by choice of soil and application of manure, but there is a general similarity between the effects of rootstock on one hand and of soil type and manuring on the other. Both soil type and manure are reflected in the elementary (especially the ash) analysis of the plant. It is known that different varieties of the same species of plant growing in the same soil differ in ash analysis, that is, each variety exercises a degree of selection in the proportions in which it takes up elements from the soil. If the rootstock continues to exercise this selective action after it has been worked, it can scarcely fail to exert an influence on the elementary composition of the scion. As a first attempt to apply chemistry to the elucidation of the mechanism of the effect of rootstock on scion, therefore, it was decided to examine the effect of rootstock on the elementary analysis of the scion, to seek for correlations between peculiarities in elementary analysis and horticultural character, and finally to attempt the modification of horticultural characters by modifying experimentally the elementary composition.

Accordingly, trees of the same variety but on two markedly different rootstocks grown close together were in the summer of 1928 separated into various anatomical fractions and 'ashed'. The ashes were examined spectroscopically by Prof. H. Dingle of the Imperial College, London, who reported many quantitative differences between the ashes of corresponding parts of the trees on the two rootstocks and one qualitative one; the six trees on rootstock type ix contained molybdenum, the element not being detected in any of the ten trees on rootstock type xii. In the young trees so far examined, the molybdenum was restricted to the woody parts of the roots and of the stem up to about the level of the graft union, none being found in tissues external to the wood or in any part above the union.

Preliminary experiments in which potassium molybdate was injected into the tops of young trees on rootstock type xii failed to demonstrate any significant effect, but material of varying ages is now ready for injection of molybdates into all parts, including the roots, in the hope of throwing light on the function of the element.

The effect of molybdates on the polarisation of organic acids³ invites speculation as to the function of molybdenum.

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¹ H. ter Meulen, *NATURE*, 130, 966, Dec. 24, 1932.

² Roach, "Annual Report of the East Malling Research Station II, Supplement", 1928-30, 101-110; 1931.

³ Patterson and Buchanan, *J. C. S.*, 3006-19; 1928.

Fluorescence of *Lolium* Seedlings in Ultra-Violet Light

DURING the past three seasons (1930-32) we have carried out selfing, hybridisation and back-cross experiments with *Lolium perenne* L. and *Lolium multiflorum* Lam. with a view of ascertaining the mode of inheritance of the factors responsible for the ultra-violet light fluorescence reaction. The considerable amount of data now to hand strongly confirms our original expectations¹.

- (1) The capacity to fluoresce is heritable.
- (2) Normally *L. perenne* is pure for non-fluorescence and *L. multiflorum* for fluorescence.

(3) Fluorescence is dominant in the F_1 generation of the cross, pure fluorescent \times pure non-fluorescent.

(4) The F_2 generation gives a ratio not significantly differing from 3 fluorescent to 1 non-fluorescent.

(5) The back-cross $F_1 \times$ pure fluorescent gives all fluorescent progeny and the back-cross $F_1 \times$ pure non-fluorescent gives a ratio approximating to 1 fluorescent to 1 non-fluorescent.

(6) We have found no genetic linkage between fluorescence and (a) the possession of awns on the lower flowering glumes, (b) shoot veneration, (c) longevity (data limited), or (d) vigour (data limited).

A number of these conclusions do not agree with those of Nilsson², but some of them are in agreement with deductions derived from 1931 selfing experiments reported by Corkill³. In our work the F_1 plants from the crosses *L. perenne* \times *L. multiflorum* and vice versa were highly self-sterile; this made genetic analysis more difficult.

The investigation was designed to elucidate the curious fluorescence behaviour of *L. perenne* strains. Broadly speaking, each strain has a constant content of fluorescence reactors (after making due allowance for the admixture of *L. multiflorum* which is present to some extent in most commercial lots). This content is lowest in the case of superior (from an agronomic point of view) and highest in the case of inferior strains. We have examined some sixteen different strains from nine countries and find the correlation distinct and striking. It is particularly noticeable in the case of New Zealand lots^{1, 4}.

The content of fluorescent reactors thus provides a gauge of agronomic merit. This might be ascribed, at first sight, to the non-fluorescent fraction being *ipso facto* superior to the fluorescent portion in each strain, the latter representing the segregants of *L. perenne* \times *L. multiflorum* crosses and the fluorescence being linked to the *L. multiflorum* 'inferior' characters. This theory is, however, untenable, since we have not, so far, found any evidence of linkage between fluorescence and (a) biennial habit, or (b) growth vigour. Further data are required in this connexion.

An alternative tentative hypothesis, which seems more likely, depends on the assumption that *major* degeneration in *L. perenne* strains is due to hybridisation with *L. multiflorum* in the first instance. There is collateral evidence for this view. These so-called species readily inter-cross, and although the F_1 plants are partially self-sterile, back-crossing takes place without difficulty. Segregants of such crosses are inferior from an agronomic point of view. The proportion of *L. perenne* \times *L. multiflorum* heterozygotes present in a strain (and hence the degree of agronomic degeneration) is the resultant of a complex of causes mainly of a cumulative and interdependent nature, and its rate of increase or decrease depends on the balance between the group of influences tending to cause and perpetuate hybrids and the group operating in the other direction. Should equilibrium between these groups be attained (and assuming random mating) the proportions of homozygotes and heterozygotes present in the population would remain constant from generation to generation. This is true in respect of the characters directly governing agronomic value; it is also true of those concerned with fluorescence capacity. On the other hand, should equilibrium be disturbed so as to favour the production and perpetuation of

hybrids, then the strain as a whole would deteriorate. But such a deterioration would necessarily be accompanied by an increase in fluorescence reactors. Consequently, the content of fluorescence reactors must be proportional to the degree of hybridisation, and hence of agronomic degeneration. It follows that the fluorescence content of a strain of *L. perenne* is a measure of its agronomic merit, not because the reacting individuals are inferior to the non-reacting ones by reason of linkage with inferior agronomic characters, but because it gauges the amount of *L. multiflorum* 'blood' in the strain as a whole.

In contrast to what we describe above as *major* degeneration, there will naturally be deterioration in cases where unfavourable selective influences act on populations of pure *L. perenne* individuals in the absence of *L. multiflorum* or hybrids. We have no reason to think that such relatively *minor* degeneration can be measured by a fluorescence test.

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¹ *Sci. Proc., Roy. Dub. Soc.*, **20**; 1931.

Comp. de l'Assoc. Internat. d'Ess. de Semences., **18**; 1931.

² Thesis for M.Agr. Degree, Queen's University, Belfast, May, 1932.

³ *Botaniska Notiser*, 1930.

⁴ *NATURE*, **130**, 134, July 23, 1932.

⁵ *Foy, New Zealand J. Agr.*; 1931.

Teaching of Biology

I SHOULD like to comment on the account of the proceedings of the Association of British Zoologists, so far as they relate to zoology in secondary schools¹. I write as a schoolmaster, knowing that my views are to some extent shared by others.

(1) We do not need vacation courses of the type of many now provided. Whereas the university lecturer is usually a specialist, the sixth-form master must have a good knowledge in all branches. Here are the subjects of four questions which have recently been set for schoolboys: the amphibian organiser; the structure, development and function of nephridia; adaptive radiation of insects; ciliary action. I do not complain of these, but I do ask that the universities which set such questions recognise that there are men in the schools who can answer them, and are thirsting for more knowledge of the same standard. I believe the Board of Education uses the term 'refresher course', and refreshes our memories of the dogfish and frog. What we need is instruction in recent advances, and contact with those engaged in research. Much might be done here informally, at least for schools near universities, and formally by the granting of a sabbatical year, in which the schoolmaster could attend a university course. Obviously the latter cannot be realised without the approval of the Board of Education.

(2) I welcome Prof. H. G. Cannon's suggestion that improvement must come through university syllabuses; for pupils who are dependent on scholarships for their college career or on the School Certificate for their livelihood, it is the only way in which it can come.

(3) Few biology teachers have trained laboratory assistants, yet most of us are sent out from the university with no notion of how to do such things as culturing *Amoeba* or killing a rabbit, unless we learnt at school. It should not be impossible to

include more 'laboratory method' in a university zoology course, with advantage to others besides the future schoolmasters. Fieldwork—both collecting and ecology—might also have more attention paid to it.

Most of what I have written applies, *mutatis mutandis*, to botany also.

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Jan. 24.

¹ NATURE, 131, 88, Jan. 21, 1933.

Nuclear Moments of the Gallium Isotopes 69 and 71

AN examination of hyperfine structure in the visible lines of the Ga II spectrum with a Fabry-Perot interferometer has shown the patterns due the individual isotopes to be distinctly separated by a difference in the magnetic moments of the nuclei. This permits the mechanical moments to be separately determined as $i = 3/2$ for both isotopes, in accord with previous determinations from incompletely resolved structures in Ga I lines¹ and Ga II lines². The ratio of the $g(i)$ factors, given by the relative magnitudes of the hyperfine term separations, is 1.27, the less abundant isotope 71 having the larger magnetic moment.

These results are obtained from the structures of the $4s5s\ ^3S - 4s5p\ ^3P$ and $4s5p\ ^3P - 4s5d\ ^3D$ lines. The $4s4d\ ^3D - 4s4f\ ^3F$ lines, although not as well resolved, stand in qualitative agreement. The

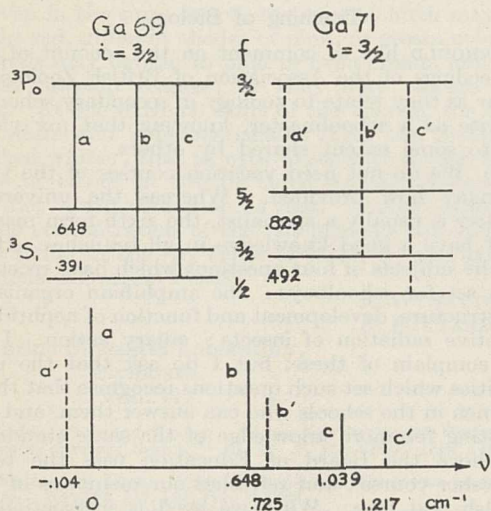


FIG. 1.—Hyperfine structure of λ 6456 in the spectrum of singly ionised gallium. The components due to 69 are indicated with full lines, those due to 71 with dotted lines.

observed structure of the line $^3S_1 - ^3P_0$ λ 6456 is given in Fig. 1, together with the term schemes. The centre of gravity of the 69 triplet, calculated from the theoretical intensities, falls at 0.389 cm^{-1} , that of the 71 triplet at 0.393 . Since the difference between these is not much greater than the probable errors in the measurements, it is safe to conclude only that an isotope shift, if present, is very small. The fact that components a' and b' , of theoretical intensities $3\ c_{71}$ and $2\ c_{69}$ respectively, are photographed with very nearly equal densities at various exposures, gives the abundance ratio $c_{69}/c_{71} = 1.5/1$.

The difference between the $g(i)$ factors observed here is noteworthy in that the only other example of

isotopes with equal spins and unequal hyperfine separations is that of thallium, where the lighter isotope (as in the present case) exhibits separations 1 or 2 per cent smaller than those of the heavier isotope³. The remaining isotope pairs which have been reported with some certainty to have equal spins are copper 63, 65⁴; bromine 79, 81⁵; cadmium 111, 113⁶; rhenium 185, 187⁷. None of these has shown a perceptible difference in the hyperfine separation constants. It is true, however, that the hyperfine structure of the last four elements named is not so well suited to the observation of small differences as is the structure of the thallium lines, and it is possible that the gallium isotopes are exceptional only in the degree to which their magnetic moments differ.

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Dec. 24.

¹ D. A. Jackson, *Z. Phys.*, **75**, 229; 1932.

² J. S. Campbell, *Phys. Rev.*, **40**, 1040; 1932.

³ H. Schüler and J. E. Keyston, *Z. Phys.*, **70**, 1; 1931.

⁴ R. Ritschl, *ibid.*, **79**, 1; 1932.

⁵ S. Tolansky, *Proc. Roy. Soc. A*, **136**, 585; 1932.

⁶ H. Schüler and H. Brück, *Z. Phys.*, **56**, 291; 1929. S. Goudsmit, *Naturwiss.*, **17**, 805; 1929.

⁷ W. Gremer and R. Ritschl, *Z. Instrumentenkde.*, **51**, 170; 1930.

Negative Polarisation in Fluorescence

IN an important paper¹ Wawilow has reported measurements on the polarisation of fluorescence of solutions of some dye-stuffs in glycerine, when excited by radiations of different wave-lengths. Using for

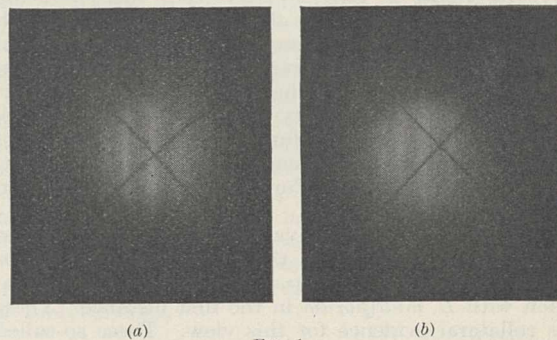


FIG. 1.

excitation the radiations from a mercury lamp, isolated by a quartz monochromator, he finds that the degree of polarisation shows a marked dependence on the wave-length of the exciting light. Starting from the visible region of the spectrum, as the wave-length of the exciting light is diminished the degree of polarisation decreases rapidly, passes through a minimum value (corresponding, in general, to excitation by λ 3125–3131), and rises again as we proceed farther towards the ultra-violet. The minimum value is usually *negative*; that is, the intensity of the fluorescent vibrations along the direction of propagation of the incident light is greater than that of vibrations in the perpendicular direction.

It is known, however, that the light that issues from a quartz (crystalline) monochromator is, in general, considerably polarised, and that the direction and the extent of polarisation fluctuate as we proceed along the spectrum. We have therefore repeated

Wawilow's measurements using linearly polarised light for excitation and observing along the normal to the plane containing the direction of propagation and the direction of vibration of the exciting light. Though our values differ considerably from those calculated from Wawilow's results (the polarisation varies also with the concentration of the dye-stuff), the general nature of the variation of polarisation with the exciting wave-length, and also its negative value for excitation by λ 3125-31, are fully confirmed. The change in sign of the polarisation in the case of fluorescein solution occurring when the exciting wave-length is changed from λ 4358 to λ 3125-31, is seen clearly in Fig. 1 (a) and (b), which are photographs of the fluorescent radiations excited by λ 4358 and λ 3125-31 respectively, taken through a suitably oriented Savart plate and analyser. The images of a fixed cross-wire which appear in the photographs, serve as reference for the positions of the fringes. It is easily seen that whereas in Fig. 1 (a) the centre of the cross-wire falls on a bright fringe, it falls on a dark fringe in Fig. 1 (b).

Also observations along different directions show for λ 3125-31 excitation that the intensity of the fluorescent radiations vibrating normal to the direction of the vibrations of the exciting light is always greater than that of fluorescent vibrations along the direction of the exciting vibrations.

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Dec. 23.

¹ *Z. Phys.*, 55, 650; 1929.

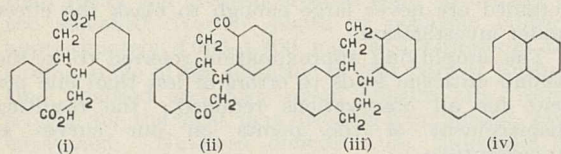
Synthesis of Chrysene and Certain Derivatives

THE very interesting letter of Messrs. Cook, Dodds and Hewett¹ on the subject of the oestrus-producing action of a keto-tetrahydrophenanthrene contains a statement that experiments are being made with the object of converting this ketone into ketohydroxy-œstrin.

We have also been engaged in synthetic studies in this group for some time and therefore, in the hope of avoiding duplication of research, we take an early opportunity of indicating the lines on which we are proceeding.

The method is similar in principle to that of Braun and Irmisch² but the stages are effected in a different manner and the yields of pure products have been greatly improved.

β : β' -Diphenyladipic acid (i) (*meso*- and *rac*-), is accessible in several ways, for example, by reduction



of ethyl cinnamate (or benzylidenemalonic ester, etc.) by means of aluminium; it suffers twofold dehydration on treatment with hot 85 per cent sulphuric acid giving the diketo-hexahydrochrysenes (ii) (*cis*- and *trans*-). Reduction of the *cis*-diketone by Clemmensen's method affords a hexahydrochrysene (iii) the constitution of which is confirmed by its dehydrogenation by selenium to chrysene (iv).

Starting with the appropriate substituents in the benzene rings (possibly β : β' -dianisyladipic acid will serve the purpose) we can see our way, as clearly as any paper-synthesis allows, to the preparation of a *norketohydroxyœstrin*, that is, the natural product without its angle-methyl group.

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¹ *NATURE*, 131, 56, Jan. 14, 1933.

² *Berichte*, 64, 2461; 1931.

Sex Hormones and Cancer-Producing Compounds

A SEQUEL to the formulation of the sterols and bile acids as hydrogenated phenanthrene derivatives¹ was the suggestion² that carcinogenic derivatives of 1:2-benzanthracene might arise by abnormal sterol metabolism. No experimental evidence for ring-closure to the hydrogenated benzanthracene ring-system has yet been put forward. Whether this actually occurs or not, it seems probable that the formation of a carcinogenic compound from a sterol would involve dehydrogenation to the aromatic state, for reduction of 1:2:5:6-dibenzanthracene to an octahydro compound results in loss of carcinogenic activity. Recent investigations of the ovarian hormones support the view that such sterol dehydrogenations do occur in the animal body. Thus œstrin is a tetracyclic compound which contains one aromatic ring, and Girard³ has recently isolated from the urine of pregnant mares an œstrogenic compound which undoubtedly contains two aromatic rings.

For reasons such as these, and because the cell proliferation which characterises the œstrous state is in some respects reminiscent of the early stages of a malignant growth, we have sought a correlation between substances having œstrogenic action and those having carcinogenic properties. Four main lines of attack have been initiated. These are:— (a) The production of synthetic compounds of known constitution which possess œstrogenic properties. One such substance, 1-keto-1:2:3:4-tetrahydrophenanthrene, has already been described⁴. (b) The examination for œstrogenic activity of compounds containing the same ring-system as carcinogenic hydrocarbons, but with polar groups present and with some rings partially reduced. One such compound, 9:10-dihydroxy-9:10-di-*n*-butyl-9:10-dihydro-1:2:5:6-dibenzanthracene⁵ has now given positive results. (c) In addition, we have found œstrus-exciting activity to be possessed by the two most potent carcinogenic hydrocarbons yet known, namely, 5:6-*cyclopenteno*-1:2-benzanthracene⁶ and 1:2-benzpyrene⁷. We confess that this last result was entirely unexpected; it is very striking that both types of biological activity should be shown by one and the same compound. (d) The examination for carcinogenic activity of œstrin and related compounds, especially the basic aromatic hydrocarbon 1:2-*cyclopentenophenanthrene*, is being undertaken.

The technique of testing for œstrous activity was that described in *NATURE* of January 14. The difficulties of solubility of the three compounds reported was very much greater than was experienced hitherto, and in all three cases 100 mgm. of substance was injected in a suspension in sesame oil. It is impossible to obtain any idea of the potency of the substances

relative to oestrin from these determinations owing to the extremely slow absorption. These tests must therefore be regarded as qualitative reactions for oestrogenic activity, but the results are none the less conclusive. The 9:10-dihydroxy-9:10-di-*n*-butyl-9:10-dihydro-1:2:5:6-dibenzanthracene, when injected in the quantity described above, gave a full oestrous response in all the ten animals injected, and the oestrus is continuing after 150 hours. With regard to the two carcinogenic hydrocarbons, 5:6-cyclopenteno-1:2-benzanthracene gave four oestrous responses lasting 150 hours out of ten animals, whilst 1:2-benzpyrene gave three oestrous responses lasting 150 hours out of ten animals. It would appear from these results that these two latter compounds have a feebler oestrus-producing action than the former.

In reporting these very suggestive results, we wish expressly to emphasise that, at the present stage, there is no evidence whatever that carcinogenic compounds arise from oestrin in the animal body. We merely record our observations that pure synthetic compounds of known molecular structure can possess both carcinogenic and oestrogenic activity.

We have commenced experiments (in collaboration with Mr. C. L. Hewett and Mr. W. Lawson) which have as their aim the synthesis of ketohydroxyoestrin and compounds of allied structure.

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Courtauld Institute of Biochemistry,
Middlesex Hospital, W.1.
Feb. 3.

- ¹ Rosenheim and King, *Chemistry and Industry*, **51**, 464; 1932.
Wieland and Dane, *Z. Physiol. Chem.*, **210**, 268; 1932.
² Kennaway and Cook, *Chemistry and Industry*, **51**, 521; 1932.
³ Girard, *C. R. Acad. Sci.*, **195**, 981; 1932; **196**, 137; 1933.
⁴ Cook, Dodds and Hewett, *NATURE*, **131**, 56, Jan. 14, 1933.
⁵ Cook, *J. Chem. Soc.*, 496; 1931.
⁶ Cook, *J. Chem. Soc.*, 2529; 1931.
⁷ Cook, Hewett and Hieger, *NATURE*, **130**, 926, Dec. 17, 1932.

Glutathione, Iodoacetic Acid and Glucose Metabolism

WITH reference to Dr. Dickens's interesting letter in *NATURE* of January 21 (p. 130) I may, perhaps, be allowed to make a brief statement. My colleague, Mr. A. H. M. Wheatley, and I submitted for publication in the *Biochemical Journal* on November 1 a paper containing the following observations.

(1) The toxicity of iodoacetic acid *in vivo* is greatly diminished or eliminated by admixture with sodium thiosulphate. Iodimetric estimations showed that one molecule of iodoacetic acid combines with one molecule of sodium thiosulphate.

(2) The powerful inhibitory action of small concentrations of iodoacetic acid on the oxidation of glucose by brain tissue is diminished or eliminated by the addition to the brain tissue of glutathione, cysteine or sodium thiosulphate. The evidence showed that there is a direct interaction between the sulphur compounds and iodoacetic acid, the halogen atom of this acid being clearly very labile. Dr. Dickens's observations support this conclusion.

(3) It appeared possible from the evidence that the toxicity of iodoacetic acid towards biological processes might be linked with its ability to combine easily with sulphhydryl compounds, and, hence, that the naturally occurring sulphhydryl compound, glutathione, might be playing some part in the processes

inhibited by the halogen acid. This conclusion was confirmed by experiments on the action of glutathione on the fermentation of glucose by baker's yeast under aerobic conditions. It was shown that the addition of glutathione to baker's yeast increases the rate of carbon dioxide output in presence of glucose to a value approaching that obtained by the yeast under anaerobic conditions. The oxygen uptake, on the other hand, was slightly inhibited by the presence of the sulphhydryl compound. Glutathione affects markedly the relationship between fermentation and the respiration of yeast in the presence of glucose.

The observations recorded above were made before the appearance of Lohmann's paper on the influence of glutathione on glyoxalase activity. It is likely that there is a close connexion between the effects of glutathione on glucose breakdown on one hand and glyoxalase activity on the other, and the conclusion seems warranted that glutathione in the living cell plays a dominant rôle in the dynamics of glucose metabolism.

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Rate of Burning of Colloidal Propellants

IN *NATURE* of January 14, A. D. Crow and W. E. Grimshaw have discussed our method of analysing some of their experimental results, and offer the following criticisms:

(1) The method of correcting for energy losses is invalid when applied to differential methods of analysis.

(2) A simplifying approximation we make in calculating the correction leads to serious error.

The first criticism is beside the point, since our method is not a differential method. After adequate trial we discarded both differential and integrating methods and our reasons for doing so are stated in our paper. Our method is a direct method, each point on our curves being based on one observation and one only of pressure and time, independent of previous and subsequent observations. The cooling correction applied at each point is based on the same assumption as that of Crow and Grimshaw, namely, a mean gas temperature holding up to the moment under observation. This assumption is sufficient for the purpose of assessing the energy loss up to this moment, provided the mean temperature does not differ greatly from that at complete combustion. Except for the first two or three observations of each series (which we discard) this condition holds. The resulting corrections to the observations retained are never large enough to mask the effect under investigation.

The simplifying approximation referred to in the second criticism leads to errors of less than one per cent for all observations retained; the resulting displacement of the points on our curves is imperceptible.

The promise of additional material including temperature observations relieves us of the necessity of pursuing this subject further in its present form.

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G. H. HINDS.

Military College of Science,
Woolwich, S.E.18.
Jan. 23.

Research Items

Mother Goddess in India. Mr. Kalipada Mitra discusses in the *Indian Antiquary* for December the affinities of the Gây Dâņ festival in its bearing on the cult of the mother goddess in India. It is suggested that it is a survival of a ceremonial sacrifice offered in the past to the corn goddess, especially because of its close association with the terrible goddess Kâlî, her Lakṣmî and Alakṣmî and the Feast of Lamps. A festival known as the *Gârṣî Vrata* is observed in several districts of Bengal by women only in the very early hours of the morning on the last day but one of the year for the benefit of the cattle and the household. This is a peculiar form of worship of Lakṣmî. In several districts a clay figure of Alakṣmî is mutilated by cutting off the ears and nose, after which Lakṣmî is ceremonially installed in the house. The offerings made consist of plantains, coconut, etc., but must not include any produce of the plough-share. In Vikrampur, when the household rises, a conch is blown and a torch is lit and carried into every room while an elderly woman chants verses ordering out vermin and bidding Lakṣmî enter. In eastern Maimansingh this ceremonial is regarded as some sort of worship of a deceased mother-in-law. An effigy of the mother-in-law in the form of a rice-paste female figure with a babe in her lap, accompanied by rice-paste figures of four kites and four crows with the effigy of a pig, is set up by a small tank dug in the courtyard for the purpose. When the pig has been sacrificed to the female figure, she with the other figures are buried in the tank. This ceremonial seems to lead up to the ancient cult of the mother goddess. Similar figures in terracotta have been found at Patna, Buxar and Kumrahar, through which both in form and association connexion is here traced with the figurines of Mohenjo-daro and Harappa as well as with the mother-goddesses of Sumer and Crete.

Late Neolithic Fortress, Homolka, Bohemia. A preliminary report on the excavation of a late neolithic fortress at Homolka in Bohemia by the second and third archæological expeditions to Central Europe of the Peabody Museum, Harvard University, and the University Museum of Philadelphia, in the seasons 1930, 1931, is made by Vladimir J. Fewkes (*Proc. Amer. Phil. Soc.*, 71, No. 6). A preliminary reconnaissance in 1929 tested nineteen sites in Bohemia which yielded evidence of fourteen different cultural phases from the earliest neolithic to twelfth century Slav. The top of Homolka resembles a roughly pointed horseshoe, greatest length a little less than 100m. and greatest breadth 60m. It belongs to the so-called 'Nordic' phase of neolithic culture, approximately 2,000-1,800 B.C., and represents the closing stage of the neolithic in this part of Europe. One hundred and forty-seven culture pits, representing for the most part dwelling-foundations, were excavated. Nineteen definite huts, indicated by well-defined traces of posts, were found. Pits and post-holes were cut in shale. Huts ran in rectangular shapes, approximately 4.25-6.50 m. in length and 3-5 m. in width. Three rows of posts, two walls and a centre line supporting the ridge pole are characteristic of the earlier huts. Sub-pits, three or four in number, are usual, their purpose being distinguishable, such as fire-pits, work-shop with anvil, etc. Fire-

places of clay, or in one case with a pebble-bed, and, possibly, traces of benches were observed. The walls were plastered on light parallel poles. There is no evidence of wicker-work of wattle and daub. Two palisades, belonging to different periods, were present. Pottery was found in large quantities, and is now being studied with important results. The oldest type shows affinities with Jordansmühl. Later, innovations were introduced from both south and north. Quantities of bone and antler work and shells from the Mediterranean or Adriatic were found. The site is a unique archæological monument in Central Europe.

Effect of Pit-Head Baths. The *Human Factor*, vol. 6, No. 12, contains an article on "Pit-Head Baths", by Mr. J. H. Mitchell, who is the holder of a Miner's Welfare national scholarship, and qualified to speak from personal experience. He sketches the origin and development of the scheme, and the reasons and prejudices behind the miners' initial rejection of it. These, he alleges, are, their fundamental conservatism, natural opposition to the necessary weekly deduction from wages, and a host of curious yet real objections, such as distrust of the employers' real intentions, and fear of too much washing. He gives a clear exposition of the installation of the baths, and the procedure adopted, and details the far-reaching effects, both observed and to be expected. Six months after their inception, lost time due to sickness and accidents was definitely decreased, although voluntary absenteeism (for reasons he explains) had arisen. Demands for overtime are frequent and unforeseen in the industry, and the invigorating effect of the bath facilities have proved physically and psychologically invaluable. Mr. Mitchell foresees, as a consequence, a great change in the miner's home life.

Birds of the Natuna Islands. The Natuna Islands extend for some two hundred miles in the South China Sea, north-west of Borneo. They comprise a few main islands, with numerous islets and rocks. Ornithological knowledge of the Islands dates from 1893, and now Harry C. Oberholser reviews all the information bearing upon the birds of this interesting area (Smithsonian Institution, *U.S. Nat. Mus., Bull.* 159, 1932). The fauna is of the continental island type, its relationships being with the other islands of the South China Sea and the neighbouring land masses. Of 108 breeding species and sub-species (19 species occur as migrants only) 26 are peculiar to the Islands, their nearest relatives being in Borneo (12), the Malay Peninsula (11), Sumatra (9), the Anamba Islands (4), and Java (2). Of the 76 remaining forms, some are confined to a limited East Indian area, while others have a wide range in the Oriental and Australasian regions. Analysis shows that the birds of the Natuna Islands are most closely related to the fauna of Borneo, less closely and about equally to the faunas of the Malay Peninsula and Sumatra, about half as much to Java as to Sumatra, still less to the Anamba Islands, and least of all to Indo-China.

Nerve-Net of Hydra. Carl H. McConnell (*Quart. J. Micr. Sci.*, 75, Pt. 3, 1932) has traced the development of the ectodermal nerve-net in the buds of *Hydra*. After trial of various methods of vital staining, he

adopted the rongalit white technique, which is carefully described. The nerve cells develop from the interstitial cells of the ectoderm and by the time the tentacle area makes its appearance in the bud, the interstitial cells which are to become nerve cells begin to send out processes between the epithelio-muscular cells of the newly forming ectoderm, and as further development proceeds a small area of nerve-net is formed by the growing together of processes from the ganglion and sensory cells. These processes advance in a pseudopod-like manner between the epithelio-muscular cells until they meet and fuse with processes from other ganglion cells. Other processes from the ganglion cells grow out in various directions and end among the muscle processes of the epithelio-muscular cells but there are no differentiated nerve endings. It appears that the long connecting processes develop first and the short, free-ending motor processes later. The author states that on many occasions he has been able to observe a perfect net under the epithelium of brown *Hydra* but the connexions between the nerve elements are easily broken by pressure of the cover-glass. The development of the nerve-net proceeds downwards from the tentacular to the basal or foot pole of the *Hydra*. The author found no connexions between the nerve cells and the cnidoblasts. He figures developing sensory cells and developing and fully formed ganglion cells, bipolar and multipolar.

Eradication of the Stinging Nettle. The distribution and control of the great stinging nettle, *Urtica dioica*, is the subject of an interesting article by G. H. Bates in the *Journal of the Ministry of Agriculture*, vol. 39, p. 912. Although not an arable weed, this plant frequently becomes troublesome on grass, and apart from any other reason it gives a general appearance of neglect on property where it occurs in any great quantity. A careful study of the chief natural habitats of the nettle have led the writer to refute the old idea that it is a nitrophilous and shade-loving plant and actual soil analyses are brought forward in support of his view. Cover, rather than high nitrogen content, was found to be characteristic of the sites most liable to infestation, and the chief causes of an invasion of nettles on grassland, molehills, stick heaps, ditch clearings for example, bear out this theory. As regards the best methods of eradication of nettles from grassland, opinion is somewhat various, but both chemical and mechanical means have been used successfully. As an example of the first type of method, spraying with a 5 per cent solution of sodium chlorate may be mentioned. This has proved very successful on the Continent and should be applied at the rate of 1 gallon per square yard after the shoots have been cut down so as to ensure the underground parts of the plant being reached. A simple but effective mechanical method of eradication is cattle treading. The placing of a feeding trough or salt lick in the middle of a patch of nettles has been shown to bring about a complete clearance of the pest, and the consolidation of the ground only temporarily affects the grassland itself.

Pitchblende at Great Bear Lake, Canada. It is already well known that the pitchblende deposits at LaBine Point, though difficult of access, probably constitute the most valuable source of radium yet discovered. A comprehensive report on the occurrences has been prepared by H. S. Spence (Investigations of Mineral Resources and the Mining Industry,

1931, pp. 55-92, 1932, Department of Mines, Canada). Four types of mineralisation have so far been found: (a) pitchblende-quartz veins with important amounts of native silver; (b) native-silver-rhodochrosite veins; (c) silver-cobalt-carbonate veins; and (d) cobalt-bismuth-quartz veins. Of these, (d) is definitely later than the others, the relative ages of which have not yet been established. Samples of pitchblende taken at a dozen different openings on the two principal veins, representing roughly hand-graded ore, have been analysed in detail. They show 25.73-52.68 per cent of uranium and 5.82-13.40 per cent of lead. Atomic weight evidence has proved that the lead is almost pure uranium lead, corresponding to the facts that thorium is absent from the mineral and galena no more than a very rare accessory. The age of the pitchblende is estimated at about 1,300 million years, a figure which presumably implies an early Pre-Cambrian (Keewatin) period of ore deposition. It is of interest that the samples giving the lower values for uranium are leached surface specimens. The presence of rich deposits of native silver adds additional interest and economic value to the occurrences.

Rainfall in Dahomey. "Die Niederschlagsverhältnisse des alten deutschen Schutzgebietes Togo" is the title of a memoir by Dr. Raoul Pignol which is No. 6 of Band 49 of *Archiv der Deutschen Seewarte*, but is published separately. It deals with the climate—more particularly the rainfall—of what used to be the German colony of Togoland. The greater part of this area is now incorporated in Dahomey. On a basis of rainfall and temperature, following the system of classification of climate devised by Köppen, the country must be divided into three principal zones, which show characteristic vegetation. The southern coastal belt has two rainy seasons separated by a short, dry season in summer and a relatively long one in winter, and is classified as isothermal (annual range of temperature less than 5° C.); from the northern boundary of this zone up to about latitude 8°, the isothermal character is maintained, but in general there is only one wet and one dry season, the dry season extending from November to February or March; farther north the annual range of temperature exceeds 5° C. and the dry season is longer, extending from October or November to April or May. The rainy and dry seasons occur, according as the monsoonal indraught from the Gulf of Guinea or the dry harmattan—a north-east wind drawn from the Sahara—prevails. The analysis of the available rainfall data has been carried out with Germanic thoroughness. The different types of seasonal variation of rainfall are illustrated by graphs for representative stations, and these are followed by the main objective of the work—rainfall maps on a good open scale, showing the geographical distribution of annual, seasonal and monthly rainfall. Apart from their economic value, these are instructive examples of the monsoonal control of climate, and may usefully be compared with similar data for India.

Aeroplane Noises. The issue of the *Proceedings of the Physico-Mathematical Society of Japan* for October 1932 contains the second of two papers on the sounds emitted by revolving air screws which Messrs. Obata, Morita and Yosida have recently contributed to the Report of the Aeronautical Research Institute of Japan. Models, of about a third natural size, of six

air screws were used. The driving shaft projected through the outer wall of a building from a boxed-in electric motor and the sounds were recorded by microphone, amplifier and oscillograph. They are of three types—those due to the rotation of the screw, those due to the shedding of eddies from the blades and those due to the elastic vibrations of the shaft and blades. The oscillograph records are not strictly periodic but a representative period is analysed and the amplitudes of the component harmonics at different speeds of the screw and in different directions from it, are shown by means of curves. Full-scale observations on a moored aeroplane provided with a silencing pit were made for the Aircraft Noise Sub-Committee of the Aeronautical Research Committee in Great Britain by Mr. C. F. B. Kemp and were described by him in the March 1932 issue of the *Proceedings of the Physical Society*, London. His results are in partial accord with the theory of Dr. Paris while those of Obata, Morita and Yosida are not.

Polarisation Phenomena in Electron Scattering. E. Rupp has described further experiments on the polarisation effects obtained by scattering electrons

at gold surfaces (*Phys. Z.*, Dec. 1). In his earlier experiments, the electrons scattered at 90° by a gold foil were passed through a second thin gold foil and an intensity variation was found around the ring pattern. The latest experiment was conducted by scattering the electrons by a gold foil and allowing a pencil of electrons scattered by a gold foil to fall alternatively on a gold or an aluminium wire which acted as a second scatterer. The electrons leaving the wire in two directions parallel and antiparallel to the original electron beam were separately collected. The apparatus was adjusted until the ratios of parallel to antiparallel scattering were equal for the gold and aluminium wires, using 20 kv. electrons which were assumed not to show polarisation. When 130 or 250 kv. electrons were used this equality was not maintained, a polarisation effect altering the ratio by 3–4 per cent and 9–10 per cent respectively. The polarisation effect was destroyed by passing the electrons through a transverse magnetic field 10 cm. long and of intensity 440 gauss. (The direct deflection was compensated electrostatically.) The unsymmetrical reflection is ascribed to a magnetic moment of the electron, and its polarisation to scattering at the atomic nuclei.

Astronomical Topics

Large Group of Sunspots. A large group of sunspots in stream formation is at the present time crossing the sun's disc. The spots appeared at the eastern edge of the disc on February 1 and will disappear around the western edge on February 14; the date of central meridian passage was February 7.5. On February 2–3, the total area of the stream was 1500 millionths of the sun's hemisphere, and the area of the largest component (the following spot) about 700 millionths. This group is the largest for two years, and its appearance at the present time is an example of the vagaries of sunspots. During the last three years, the sun's activity has been declining fairly rapidly towards the minimum of the 11-year cycle, and last year on about ninety days the sun was entirely free from spots; yet the present sunspot disturbance is the third considerable group seen in the last three months. An interesting feature of this group is the inclination (about 20°) of its axis to the sun's equator, the leader spot, in latitude 16° N., being farther away from the equator than the follower in latitude $11\frac{1}{2}^\circ$ N. On February 2, the spots were active spectroscopically, and two small eruptions of bright hydrogen ($H\alpha$) were observed at Greenwich at 10^h and 15^h.

Perturbations of Comets by the Stars. A paper by E. Opik (*Proc. Amer. Acad. Arts Sci.*, Oct.) examines the effect of stellar perturbations in the case of comets or meteors which travel to great distances from the sun. It is easy to see that, since it is only the difference of action on the comet and on the sun that is effective, it is necessary to proceed to great distances before these perturbations are of any importance. It is shown that one of the effects of such perturbations is a tendency to increase the perihelion distances of the objects; it is concluded that if the aphelion distance is about ten thousand units, or one-thirtieth of the distance to the nearest star, the perihelion distance is likely to be so much increased that few, if any, of such comets would come into the sphere of visibility from the earth. Some

2,000 units is estimated as the probable greatest aphelion distance of the comets that can be seen from the earth; for meteors the lower figure of 1,000 units is adopted. If such meteors date back to the origin of the solar system, estimated to have been some 3,000 million years ago, they would have approached the sun more than a hundred thousand times; the heat experienced is estimated as equivalent to about thirty thousand years of continuous heating to a temperature exceeding 0° C. This would, according to the author's estimation, suffice to deprive a stony meteor of all its helium. This research, which is of a novel character, was undertaken in connexion with the extensive meteor work initiated at Harvard by Prof. Shapley.

Spectral Types of Faint Stars. Kapteyn's plan of "Selected Areas" included the determination of the spectral types of as many stars as possible in each area. Part of this work of classification was undertaken by the Mount Wilson Observatory, and a list of 4,066 spectral types has now been published by Dr. Humason (*Astrophys. J.*, vol. 76, p. 224). These cover the first 115 areas of Kapteyn's plan, and include stars down to the 15th magnitude (photographic). The observations were made with a slitless spectrograph at the Newtonian focus of the 60 in. reflector, which gave spectra of 7.84 mm. length from $H\beta$ to $H\epsilon$. These spectra were classified by matching with plates of standard stars, the mean of three observations being adopted as the spectral type. The principal criteria used were the hydrogen lines, the [H] and [K] lines of calcium, the [G] band and the M-type bands. The only difficulties encountered were in distinguishing between types F and B, which strongly resemble each other in such small-scale spectra if they are not strong enough to show the [H] and [K] lines. In addition to the list of observed spectral types, the author includes some statistical notes, with frequency curves for each type in different regions and for all regions together.

Royal Society Mond Laboratory

THE new Royal Society Mond Laboratory (Fig. 1) which has been presented to the University of Cambridge by the Royal Society was formally opened on February 3 by the Chancellor of the University, Mr. Stanley Baldwin.

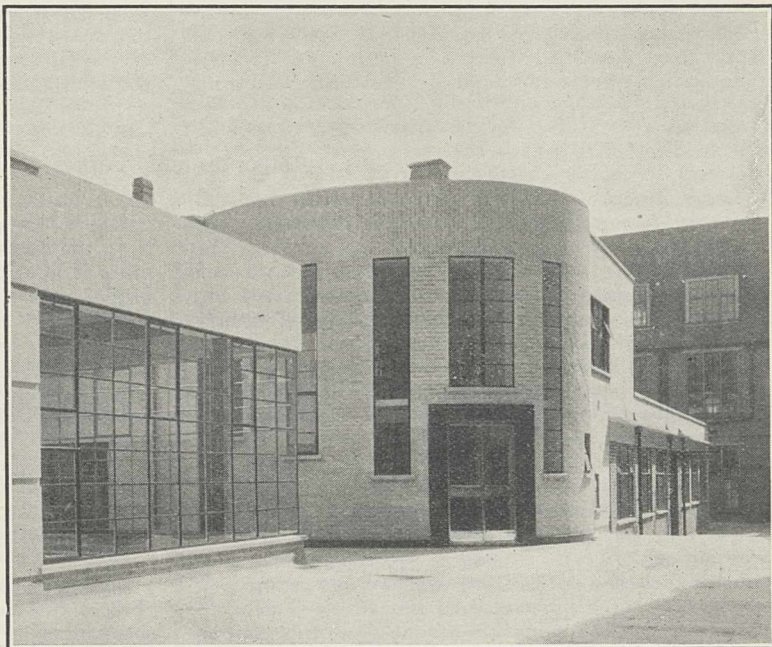
The ceremony was preceded by an official luncheon in Corpus Christi College, given by the Vice-Chancellor, Mr. W. Spens, who welcomed a large gathering representative of the Royal Society, the Department of Scientific and Industrial Research and most of the schools of physical science in Great Britain. After the luncheon, a meeting was held in the Arts School when the Cavendish Professor, Lord Rutherford, explained the purpose of the laboratory and gave an account of the early stages of the work of Prof. P. Kapitza, referring in particular to the great difficulties at the outset, when for a time it seemed almost impossible to construct coils which would not be disrupted by the large electromagnetic stresses developed during the experiments.

Sir Frederick Gowland Hopkins, president of the Royal Society, then formally presented the laboratory to the University. He referred to the connexion which has always existed between the Royal Society and the University, a connexion which has been particularly helped by the sequence of Cavendish professors who have also been presidents of the Royal Society. It was his privilege to convey this gift from an ancient but progressive scientific society to a still more ancient but no less progressive university.

Sir Robert Mond then gave a short address and spoke of the great interest his father, Dr. Ludwig Mond, had always shown in scientific research, an interest which was largely responsible for enabling Dewar's pioneer researches in low temperatures to be carried out and is now bearing further fruit in this gift, which the Royal Society has been able to make from the accumulated interest of the Ludwig Mond bequest. The Chancellor, in accepting the gift on behalf of the University, gave a brief account of the history of the work which has led to the construction of the Laboratory. After several years of preliminary experiments in the Cavendish Laboratory, Dr. Kapitza was able in 1925 to develop a method of producing magnetic fields of the order of 300,000 gauss by passing the heavy initial current from a short circuited alternator through a small coil. To obtain the large currents of the order of 15,000 amperes necessary for the work, a special alternator was required and its purchase was made possible by generous grants from the Department of Scientific and Industrial Research, which was farsighted enough to see the importance of the work and to support it during its infancy. The Department later provided the grant which enabled a liquid hydrogen plant to be constructed and thereby enabled cryogenic work to be taken up again in England after an interval of many years since Dewar's experiments.

The Chancellor reminded his audience that the greatness of a country in the eyes of the world and of history will be measured not so much by the size of its armaments or of its industries as by its permanent contributions to art, literature and science. Modern industry is becoming more and more dependent on the application of discoveries in pure science, and successful industrial research is ultimately dependent on the vigorous prosecution of research in pure science. Whilst as a statesman he would accept no responsibility for the social effects of any work which might come from the Laboratory, as Chancellor he welcomed the gift for the great addition which it makes to the facilities available for experimental physics in the University.

The new laboratory, designed by Mr. H. C. Hughes, stands in the courtyard of the Cavendish Laboratory.



Copyright: H. C. Hughes

FIG. 1. Entrance to Royal Society Mond Laboratory

It has been fortunate indeed that soon after the gift of the Royal Society had been accepted, it became possible for the University to build new lecture rooms for the Department of Engineering, and so to clear away from the Cavendish site the old engineering workshops in which the School of Engineering in Cambridge was born, thereby enabling the site to be allotted to the new Laboratory. This close proximity of the Laboratory to its parent body, the Cavendish Laboratory, cannot fail to facilitate and invigorate the work of the Laboratory, since its work is, and must continue to be, mainly physical, whilst the provision of cryogenic facilities may well exert a marked influence on the future work of the Cavendish Laboratory.

Surrounded on all sides by high buildings, the Laboratory has been designed for the most part as a single storey block with a group of first floor rooms for offices at one end. The basic idea of the plan has been to separate and isolate, so far as possible,

the research rooms from the heavy machinery which is necessary to the work of the Laboratory. The central hall shown in the plan (Fig. 2) is devoted to the main experimental apparatus of the Laboratory—the large generator which produces the very intense currents and its auxiliary apparatus. Near the generator in adjacent rooms are arranged the machine room, workshop and liquid air room. In these rooms great care has been taken to reduce the noise produced by the machinery at its source by the free use of asbestos sound absorbent; special precautions have been taken to prevent the transmission of noise through doors, and in addition, the steel frame of the building has been erected in two separate sections so that there can be no direct transmission of vibrations from the machine end to the research end of the Laboratory. The roofs of the two sections overlap and only lead aprons, a mortar joint filling and two insulating pads join the two sections. The result of these precautions has been very satisfactory, the noise of the machines and

are installed, and it is hoped to construct the liquefier within the next few months.

The six research rooms of the Laboratory open out of the main hall at the north end. Each research room has large plate glass windows with adequate dark blind arrangements; the walls are plain distempered brick with vertical wooden strips to provide fixing accommodation for apparatus; the rooms are heated by panel radiators fixed on the ceiling to economise floor space. An even temperature is ensured in all the research rooms, first by fitting thermostatically controlled valves to all radiators, and secondly by having an oil-fired boiler with thermostatic control of the water temperature.

In each room a concrete galvanometer foundation goes down to a depth of 10 ft. and heavy section earthing rods should ensure that independence of extraneous electrical disturbances which is so essential for magnetic researches. A cross-connexion switchboard in the main hall enables any one of five different machines to be connected to and controlled

from any desired room; at the same time each room has available a separate switchboard on which are a 220 volt battery, four terminals which can be connected to any desired cells in a 110 volt battery, a three wire automatically regulated 110/220 volt D.C. supply, a four wire 3-phase A.C. supply and a galvanometer lamp supply. From the switchboard an overhead grid allows the supply to be conveyed neatly to any table in the room. Self-starting synchronous clocks have been installed in each research room in place of the half minute impulse clocks, to eliminate the magnetic disturbances which are apt to be introduced by the impulse type. All the synchronous clocks are fed from a central point near a master clock which is fitted with both synchronous and impulse dials, and a frequency change arrangement enables all the clocks to be actuated from this point should a failure of supply lead to stoppage. The master clock is also used to provide seconds impulses to any

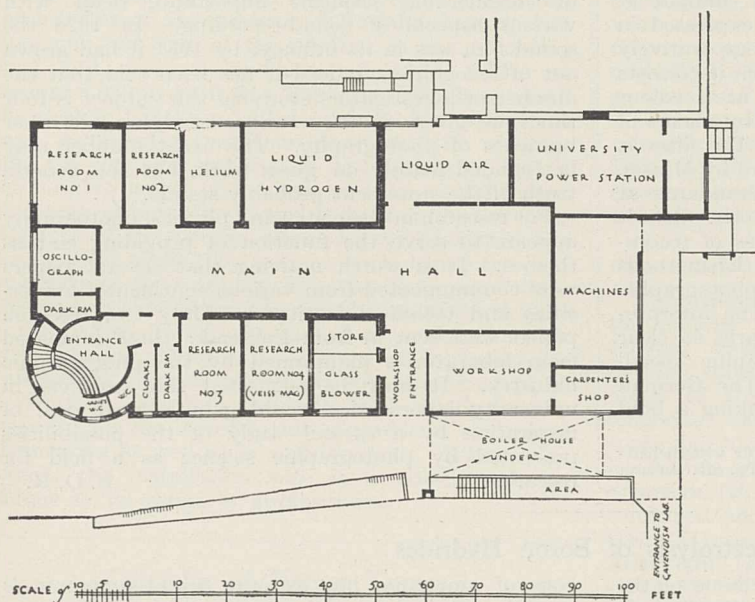


FIG. 2

liquid air plant being practically inaudible in the rest of the laboratory.

The liquid hydrogen plant already described in NATURE (129, 224, Feb. 13, 1932) has been removed to the new Laboratory, the only change made being in the system of gas storage. In place of cumbersome oil-filled gas holders which are usual for this work, a very small gas holder is used having a capacity of about 1 cubic metre, the main volume of the gas being stored at 10 atmospheres pressure in hollow steel forgings, automatic pumping plant being installed to convey the gas from the storage cylinder to the gas holder as required. In this way it is hoped to minimise the diffusion of air impurities from the oil of the gas holders into the hydrogen, one of the most common sources of trouble in liquefaction work. A further advantage lies in the great reduction of space effected, and as a result it has been possible to house both a hydrogen and helium liquefaction plant in a room about 25 ft. x 18 ft. The compressors and storage system for the helium liquefaction

room if required.

Every advantage has been taken of the flexibility allowed by modern building materials to meet the special requirements of the Laboratory at the least possible expense. As a result, the average cost has been less than 1s. 3d. per ft. cube, of which 10 per cent was for special foundations. The main decorative features of the interior are the attractive modern furniture designed by the architect, Mr. H. C. Hughes, and the gay colourings of the pipes conveying the different services. The only decorative feature of the exterior is the crocodile rampant excised in the white bricks by Mr. Eric Hill. Of the many explanations of the significance of this carving, we may record one—to the sculptor at least it signifies "Science Devouring Culture". The exterior of the building has been faced with white Leighton Buzzard bricks; these together with the large plate glass windows and circular entrance give the building a modernist character, whilst at the same time its simplicity should enable it to be a harmonious neighbour to its very mixed surroundings.

International Congress of Scientific and Applied Photography*

THE first International Congress of Photography was held in Paris in 1889. Congresses followed at Brussels in 1891, Paris in 1900, Liège in 1905, Brussels in 1910, Paris in 1925, London in 1928 and Dresden in 1931. It is hoped to continue the meetings triennially and the next one will probably be held in America in 1934. The recently published report of the proceedings of the eighth Congress affords a very good view of the activities of the organisation.

Standardisation of photographic sensitometry has since 1925 been one of the principal objects of the Congress. National committees for dealing with this problem have been set up in Germany, England, France and the United States. After discussions and researches lasting over three Congresses, agreement has at length been reached on a photographic unit of daylight for the testing of such materials as are to be used in daylight. The standard approaches very closely the quality of mean noon sunlight at Washington, and intensities are to be expressed in visual candles. The standard light is comparatively easy to reproduce in the laboratory since it consists in a vacuum electric lamp operating at a colour temperature of 2,360° K. and corrected by means of a two-cell liquid filter of blue colour. The filter is one of a series worked out with great care by Messrs. Davis and Gibson of the Bureau of Standards at Washington and is easily prepared. In other details of the technique of sensitometry a series of recommendations has been drawn up. Thus the methods of obtaining the characteristic curves of photographic materials have been largely unified. The interpretation of the data is, however, not nearly so clear to define; the real meaning of photographic 'speed' is still a matter of great difficulty. The German section of the Congress is, however, making a bold

* Bericht über den VIII Internationalen Kongress für wissenschaftliche und angewandte Photographie. Dresden, 1931. Pp. 445. Johann Ambrosius Barth, Leipzig.

attempt to standardise a method for the determination of commercial speed numbers. This will be very difficult because, although the standardisation of the methods of determining characteristic curves of photographic materials is now within sight, the derivation of 'speed' numbers from the curves is still a subject of acute controversy.

For cinematography the Congress also yields opportunities for achieving international standardisation in such matters as the dimensions and spacing of sprocket holes in film, the definition of the meaning of the term 'safety film', etc.

The chief interest of the Congress lies, however, in the scientific papers presented for discussion. It is interesting to watch the growth or decline of interest in various subjects from one Congress to another. The subject of sound-recording claimed only two short communications in the Congress of 1928. At the 1931 Congress, however, eight papers of considerable scientific importance dealt with various aspects of sound-recording. In 1928 the sound film was in its infancy, by 1931 it had grown out of recognition, indeed it has been said that the number of investigators studying this subject is four times as great as the number studying all other branches of photography. The exact number may be founded mainly on guess work, but the general truth of the statement probably stands.

For research in chemistry and physics, photography appears to serve the function of providing endless themes. It is worth noticing that several papers were communicated from various continental universities and technical institutes. Only two research papers were sent in from England; these emanated from laboratories maintained by the photographic industry. It may be suggested that workers in university laboratories would gain a great deal of inspiration by a careful study of the possibilities presented by photographic science as a field for research.

S. O. R.

Electrolysis of Boron Hydrides

IN a communication to the November issue of the *Berichte der deutschen chemischen Gesellschaft*, Herren A. Stock and E. Wiborg discuss the mechanism of the complex changes whereby substitution of hydrogen by amino-groups takes place when solutions of boron hydrides in liquid ammonia are electrolysed. Two distinct reactions have been traced, namely, one which produces hydrogen as the only gaseous product and one which results in the liberation of hydrogen at the cathode and nitrogen at the anode.

These two reactions have been studied in detail. The former predominates for a time but gradually dies down until eventually it is completely replaced by the latter. This stage is indicated by the settling down of the current to a constant minimum value. Solid substitution derivatives can be recovered from the solutions by evaporation of the solvent. These solids were hydrolysed in order to determine their composition. Analysis of the results shows that the hydrogen which is liberated in the first reaction is due principally to chemical substitution of hydrogen by amino-groups but that this substitution is initiated and maintained by electrolysis of the boron hydrides. The other reaction is ultimately due to the electro-

lysis of ammonia, but as pure liquid ammonia is scarcely affected by the current, it is evident that in this case also some secondary factor has to be considered.

The authors have previously shown that boroethane, B_2H_6 , acts as a dibasic acid and they are now able to trace the gradual cessation of the first or substitution-reaction to the diminution of acidity by the formation of inner salts of the amino-derivatives (after the manner of glyocoll). Some of these inner salts will still be sufficiently acidic to undergo further electrolysis and subsequent substitution, whilst others will be neutral and therefore resist further action. Thus the substitution reaction gradually fades out.

Again, the active factors in promoting the direct electrolysis of the ammonia (that is, the final reaction) are said to be the anions of the inner salts, since decomposition of ammonia is not observed in the early stages of the electrolysis. Boroethane gives rise to the compound $B_2H_4(NH_2)_2$ as the final product of substitution.

The compounds B_4H_{10} and $B_{10}H_{14}$ were also studied under similar conditions, when it was found that replacement of six and twelve hydrogen atoms respectively could be effected.

University and Educational Intelligence

CAMBRIDGE.—The Buildings Syndicate has recommended to the University that the plans for buildings for the Department of Zoology prepared by Mr. J. Murray Easton be approved and that Dove Brothers' tender of £72,363 for the work be accepted. If approval is given to this report at the earliest possible date, the first section of the new Zoological Laboratory should be ready for occupation by October 1, 1933 and the whole by October 1, 1934.

At Jesus College, Dr. H. Spencer Jones, formerly a fellow of the College, and recently appointed Astronomer Royal in succession to Sir Frank Dyson, has been elected to an honorary fellowship.

THE Royal Technical College, Glasgow, succeeded last session in fully maintaining its activities despite the continued depression in many of the industries in Glasgow and its neighbourhood. Statistics given in the recently published annual report show that the number of day students (897) falls short by less than one per cent of the number in the preceding year and evening students numbered 2,728, as against 2,880 in 1930-31. The very difficulties which the College has been called upon to face appear to have increased rather than diminished its vitality, and the financial position is satisfactory. Among the notable events of the year was the establishment of a series of bursaries to enable distinguished evening students of the College, whose higher education has been gained while they were at work during the day, to continue their studies by attendance at College day classes, thus helping to remedy one of the defects of the British system of technical education to which attention was directed in NATURE of December 24. Substantial progress was made with the erection of a five-foot diameter open-jet type wind tunnel, intended for the investigation of problems in general engineering as well as in aerodynamics. When completed, the installation will, it is anticipated, be unique in its range of applicability.

Calendar of Nature Topics

Commencement of Salmon Season

February 11.—“The trout and salmon, being in season, have . . . their bodies adorned, the one with such red spots the other with such black or blackish spots, as give them such an addition of natural beauty, as I think, was never given to any woman by the artificial paint or patches, in which they so much pride themselves in this age.” (Walton, “The Compleat Angler”.)

Walton is much less voluble than usual over the technicalities of angling in his discourse on the salmon. Probably his practical acquaintance with salmon fishing was limited. His account of salmon natural history, however, indicates the main lines of its life-history well enough, despite errors in detail such as August for the spawning month, and the notion that the growth “out of their lower chaps, not unlike a hawk's beak” develops after spawning is over. Apart from more precise determination of systematic relationships among the Salmonidæ, progress since Walton's day has consisted largely in elucidating details of salmon movements, reproduction and growth. The most notable modern

contribution is the discovery and utilisation of the fact that valuable information may be deduced from examination of the scales. Migration or marking experiments which, practised on a considerable scale during the last few decades, have yielded much, are a modern development of what seems to be a fairly old practice. “Much of this has been observed by tying a ribbon, or some known tape or thread, on the tail of some young salmon which have been taken in weirs as they have swimmied towards the salt water, and then by taking a part of them again, with the known mark, at the same place on their return from the sea.” (Walton.)

Salmon Disease

Increasing attention to fisheries, following on the interest aroused in fish hatching as a means of keeping up stock in rivers, brought ‘salmon disease’ into prominence. This disease, now known for about a century, is marked externally by growths of the fungus *Saprolegnia ferax*. Day (“British and Irish Salmonidæ”, 1887) records it as epidemic in British waters since 1878, and suggests various causes predisposing to the infection, which he considered as normally present but “requires a soil suitable to its germination”. Hume Patterson (Rep. Scot. Fish. Bd., 1903) showed the fungus masked a bacillus (*B. salmonis pestis*) the essential organism of the disease. There is still considerable though varying mortality among salmon from this cause and from time to time it has broken out in epidemic force.

Furunculosis

Furunculosis is a more serious disease and lacks the notable external sign of secondary growth of fungus. Essentially a general infection, at present nothing short of bacteriological examination of the blood of suspected fish can give a trustworthy diagnosis, although external lesions may in some cases indicate that the disease is probably present. Emmerich and Weibel (1894) isolated the causative organism (*B. salmonicida*) and their findings were confirmed and extended by Hofer (1904) and Plehn (1909-24) on the Continent; in Great Britain by Arkwright (1912), Horne (1928), and Williamson (1928-30). The disease has been known in Europe for some forty years. In the United States it came under notice rather later (Marsh, 1902). Widespread outbreaks occurred in 1909-11 in France, Switzerland, Austria and south Germany, where in 1909, 25 Bavarian rivers held diseased fish. In 1911 furunculosis reached the south-western English rivers; less than two years after there was an outbreak in Ireland (River Liffey). Since then the disease has been reported in many British rivers. A severe outbreak among Kennet trout in 1924 prompted renewed inquiry into the origin and spread of the disease. In 1926 the finding of 459 dead salmon in the upper waters of the Tay, in what would appear to be an exceptionally favourable environment for salmon, attracted the attention of the Scottish Fishery Board to the disease, which has since appeared in many widely separated Scottish rivers. In 1929 a Furunculosis Committee was appointed by the Minister of Agriculture and Fisheries and the Secretary for Scotland and in the following March an interim report was issued. The Committee found the probable immediate origin of the disease to be fish farms, whence the bacillus may be carried to different rivers by apparently healthy trout distributed for stocking

purposes. Unhindered importation of supplies from the Continent by such farms, as has occurred freely in the past, provides an easy route for the transmission of infected foreign fish.

That the English outbreak of 1911 should have followed the severe epidemics in Europe in 1909-11 is very suggestive. Transmission by casual migrants from Continental to British rivers must be excluded in view of the low viability of *B. salmonicida* in sea water (Williamson, 1928). It is therefore extremely likely that furunculosis is another case where the incautious introduction of livestock from abroad has done serious harm to the home fauna.

St. Valentine's Day. The Beginning of Spring

February 14.—Several English and French proverbs associate the beginning of spring with St. Valentine's day, when "winter's back breaks". Long-period averages for London confirm these sayings, showing that after remaining almost constant throughout January and the first half of February, the temperature begins to rise about the middle of the latter month. Persistent frosts rarely continue unbroken after this date, and even if the nights remain cold, the increasing power of the sun's rays is noticeable in a midday thaw. The crocus is expected to blossom about February 14, and is dedicated to St. Valentine.

Progress of Oceanography

On February 14, 1779, Capt. James Cook, F.R.S., was murdered by the natives of Owyhee, and the world thus lost at the early age of fifty-one years its greatest marine explorer and navigator, and one who is now universally acclaimed as the founder of the science of oceanography. On the same date, nearly one hundred years later, was made one of the most fruitful hauls of the *Challenger* Expedition, the results of the world-wide collections of which form the main basis upon which modern oceanography is built, and have dispelled for all time the belief that the deepest parts of the ocean are uninhabitable.

H.M.S. *Challenger*. February 14, 1876. Lat. 37° 17' S. : long. 53° 52' W. Station 320 (Sounding 407). Falkland Islands to Rio de la Plata.

"At 11.30 a.m. commenced heaving in trawl, which came up at 12.30 p.m., containing a little mud, five or six phosphatic concretions, and numerous specimens. This was one of the richest hauls made during the cruise."

"Excluding Protozoa, nearly 500 specimens of invertebrates and fishes were obtained at this Station, belonging to about 127 species, of which 103 are new to science, including representatives of 19 new genera; 80 of the new species and 6 new genera were not obtained elsewhere."

Societies and Academies

LONDON

Royal Society, Feb. 2. J. C. McLENNAN and R. TURNBULL: The ultra-violet absorption bands of xenon. The characteristic features of the two absorption bands in the neighbourhood of the resonance lines λ 1469.6 Å. and λ 1295.6 Å. can be explained by supposing them to be due primarily to absorption occurring during atomic collisions, when the energy levels of the colliding atoms were perturbed by their mutual interactions. At the lower pressures, mainly two-body collisions are effective, but at pressures above 90 mm. of mercury and at

room temperature, collisions between three or more atoms occur frequently enough to affect appreciably the absorption. A comparison of the absorption bands at λ 1469.6 Å. and λ 1295.6 Å. reveals that with xenon, two-atom aggregates involving one atom in the $1P_1^0$ state are less stable than two-atom aggregates having one of the constituent atoms in the $3P_1^0$ state. D. M. NEWITT and A. M. BROCH: The slow combustion of ethane at high pressures. In the slow combustion of ethane-oxygen mixtures of composition 85-90 ethane with 15-10 per cent oxygen, at high pressures, intermediate products, representing the six possible 'hydroxylation' steps whereby the ethane molecule is oxidised, have been isolated. At 100 atmospheres pressure, upwards of 60 (and in one case more than 70) per cent of the carbon of the ethane burnt survived as condensable and water-soluble intermediate products. Ethyl alcohol and/or acetic acid predominated among the surviving intermediate products but, in addition, considerable quantities of methyl alcohol, acetaldehyde and steam were always present together with smaller amounts of formaldehyde and formic acid. The effect of increasing the initial pressure of the reacting medium was in general to favour the survival of ethyl alcohol, acetaldehyde and acetic acid (that is, of products formed without any rupture of the ethane molecule).

Geological Society, Dec. 21. L. HAWKES and HILDA K. HAWKES: The Sandfell laccolith and 'Dome of Elevation'. Sandfell—a hill of rhyolitic oligoclase porphyry intruded into the plateau basalt series on the south side of Faskrudsfjord, eastern Iceland—is a laccolith which in form, relationship to the country rocks, and exposure, is comparable with the type intrusions of the Henry Mountains. The thickness of the original cover can be determined with greater precision than has hitherto been possible for such bodies, and it can be demonstrated that intrusion was accompanied by a doming at the earth's surface. The northern junction is mainly a faulted one, and the laccolith is asymmetric. S. SMITH (with notes on fossils by C. J. Stubblefield): The occurrence of Tremadoc shales in the Tortworth Inlier, Gloucestershire. Hitherto the Tortworth Inlier has been considered as entirely of Silurian age, but recently Tremadoc fossils were found by one of the authors in the soft bluish-grey shale which forms much of the northern part of the Palaeozoic outcrop. The Tremadoc rocks, for which the name 'Breadstone shales' is proposed, occupy the entire width of the inlier between Purton and Mobley and cover an area of approximately $3\frac{1}{2}$ square miles. They provide the most southerly exposure of Cambrian rocks in Britain. Their outcrop lies nearly 30 miles south of that of the Bronsil shales of the Malvern region. A. D. N. BAIN: The younger intrusive rocks of the Kudaru Hills, Nigeria. The members of the series present in these hills consist of a mass of cone-sheets and dykes surrounding pyroxene-fayalite-, riebeckite-, and biotite-granites, the riebeckite-granite forming the main intrusion. The earliest member is a very large cone-sheet consisting of a unique rock type, a pyroxene-fayalite-quartz-porphyry. The field work definitely establishes two swarms of minor intrusions, one coming before the main granites and the other and more numerous swarm, after them. The whole group has the form of an inverted cedar-tree laccolith or chonolith.

PARIS

Academy of Sciences, Dec. 27 (195, 1337-1440).
JULES DRACH: The integration by quadrature of a class of differential equations: $d^2y/dx^2 = F(x, y)$.
A. COTTON and **M. SCHÉRER**: The magnetic rotatory dispersion of a coloured diamagnetic compound, thiobenzophenone. These determinations were carried out with the liquid film only 0.13 mm. thick. For this diamagnetic liquid the anomalies of the magnetic rotatory dispersion were quite clear on both sides of the absorption band, but do not show the same characters previously noted in the case of cobalt chloride. The work will be continued with higher magnetic fields.
C. MATIGNON and **M. SÉON**: The action of steam on methane. Studies of the effects of different catalysts on the course of the reaction $\text{CH}_4 + 2\text{H}_2\text{O} = \text{CO}_2 + 4\text{H}_2$. Zirconia proved to be the best catalyst.
GABRIEL BERTRAND and **L. SILBERSTEIN**: The importance of sulphates as manure. Laboratory experiments show that the introduction of a certain proportion of combined sulphur in an assimilable form is necessary. The use of potassium and ammonium sulphates in the field is suggested as desirable.
JEAN CABANNES: The Raman spectrum of the SO_4 ion in gypsum.
A. BIGOT: The rôle of solifluxion in the morphogeny of the hills of Normandy and the Maine.
PAUL VINCENSINI: The focal points of circles of a congruence.
GEORGES GIRAUD: Non-linear equations of the elliptic type. General theorem and application.
SOULA: Integral equations of the first species with fixed limits.
JULJUS SCHAUDER: Partial differential equations of the elliptic type.
HERMAN AUERBACH: Limited groups of linear substitutions.
CARL A. GARABEDIAN: The thick rectangular plate, uniformly loaded, the two opposite edges of which at least are supported.
MAURICE GOLAZ: Remarks on the viscosity of water.
JEAN LOUIS DESTOUCHES: Remarks on the theory of superquantification.
MAX SERRUYS: The localisation of the phenomena of detonation. Experimental study of knocking in an internal combustion motor.
ANTONIO CABREIRA: The variation of the orbit and velocity of Halley's comet and its distance from the planets causing the perturbations.
TH. DE DONDER: The linearisation of any (ds^2).
A. HAUTOT: The structure of the $K\alpha$ line of carbon.
G. A. BOUTRY: The design of a low-frequency amplifier for the photoelectric cell.
P. FOURMARIER: The action of a magnetic field on a gas-filled photoelectric cell.
F. GALLAIS: Silver iodomercurate. From measurements of the coefficient of magnetisation the existence of the complex compound Ag_2HgI_4 is proved, agreeing with the conclusions of J. Ketelaar based on X-ray diagrams.
L. PALFRAY, **S. SABETAY** and **MLLE. DENISE SONTAG**: The action of various dehydrating agents on primary phenylethyl alcohol. When dehydration takes place, styrolene is formed in preference to the ether oxide.
PAUL FLEURY and **JACQUES LANGE**: The oxidation of the acid alcohols and the sugars by periodic acid. This reaction appears to be specific for the α -diols.
L. and H. LONGCHAMON: The vanadinite from Hérival (Vosges).
MLLE. HENRIETTE ALIMEN: The palæontological bases of a subdivision of the Stampian in the Paris basin.
G. DELÉPINE: The extension of the Palæozoic seas in Asturia (Spain).
MLLE. S. GILLET: An attempt at the classification of the upper Miocene and the lower Pliocene in Roumania, Transylvania and the Banat.
D. SCHNEEGANS: The subdivisions of the Ubaye sheet in the Morgon massif (French Alps).
F. M.

BERGOUNIOUX: The place of the Trionyx in the classification of the chelonians.
J. COULOMB: Researches on the magnetic anomaly at the summit of the Puy de Dôme.
IDRAC: Researches on the submarine phenomena of the bay of Villefranche-sur-Mer.
PIERRE FRÉMY: Living Cyanophyceæ in the thallus of *Codium*.
A. VLADESCO: The first partitions of the zygote in the leptosporangiate ferns.
MLLE. DZUNG TSIN WANG: Some observations on *Ustilago violacea*.
E. MICHEL-DURAND: The nitrogen, sulphur, phosphorus and potassium of the leaves of *Prunus laurocerasus* at the moment of their fall.
E. FISCHER-PIETTE, **ROGER HEIM** and **ROBERT LAMI**: Preliminary note on a bacterial disease of *Zostera*.
LÉON BERTIN: The anatomical bases of the classification of the apodal fishes belonging to the sub-order of the Lyomeres.
EMILE F. TERROINE and **MLLE. GILBERTE MOUROT**: The formation of puric compounds at the expense of protein material in endogenous nitrogen metabolism.
FERNAND MERCIER and **J. BALANSARD**: Chemical and pharmacodynamical researches on the cardiotoxic principles of *Cryptostegia madagascariensis*.
H. LABBÉ and **M. RUBINSTEIN**: The action of adrenaline on the nitrogen exchanges.
JAMES BASSET and **M. A. MACHEBŒUF**: The study of the biological effects of ultra-pressures. Resistance of bacteria, diastases and toxins to very high pressures.
M. and MME. G. S. ADAIR and **M. and MME. J. ROCHE**: Researches on the molecular weight of globin from various hæmoglobins.
CH. DHÉRE: The tegumentary porphyrin of *Lumbricus terrestris*.
S. TURCHINI: Remarkable effects of diathermo-coagulation in cancers of radiobiologists attacked by radiodermatitis.

GENEVA

Society of Physics and Natural History, Dec. 1.
G. TIEROY: The variation of ionisation and the spectrum variation of some Cepheids. The extreme spectra correspond to the extremes of ionisation and the maximum ionisation is a little ahead of the light maximum, whilst the minimum of ionisation is ahead of the light minimum.
E. CHERBULIEZ and **FR. MEYER**: New researches on casein. Following up their earlier work, the authors conclude that casein from cow's milk is a mixture of at least four constituents which have been isolated, and the proportion of which in casein is not constant.
R. WAVRE: New examples of polydromes of prolonged Newtonian potentials.
H. LAGOTALA: (1) Borings in the marly limestones of Renéville (French Congo). A description of the formations met with in the course of five borings, one of which gave the composition of the strata over 95 metres. The marly limestones found at the levels of schists (micaceous, grits, etc.) belong to the formation of the Niari limestones (schist-limestone series of Delhaye and Sluys). (2) Concerning the stratigraphic scale of the Niari limestones. It is impossible to utilise the divisions accepted by Delhaye and Sluys, and later by Babet, for the subdivision of the Niari limestones. In fact, the layers which should serve as a basis of reference are not constant in their facies. The author confines himself to establishing two groups, the lower ending with the appearance of the oolitic facies, following on a marl or clay facies.
P. BALAVOINE: Contribution to the tetrafluoride test. By the action of water on silicon fluoride, there is not only formation of silica, since, carried out in contact with glass, the reaction also causes corrosion of the glass.
C. DALLWICK: Presentation of a map produced by the projection of the sphere on the icosahedron.

Forthcoming Events

Saturday, Feb. 11

SCHOOL NATURE STUDY UNION, at 2.30—(at Botanical Theatre, University College, Gower Street, W.C.). Annual Conference. At 3—Sir Frank Dyson: "Astronomy—Old and New".

Monday, Feb. 13

ROYAL GEOGRAPHICAL SOCIETY, at 5.—A. C. O'Dell: "The Urbanisation of the Shetland Islands".

UNIVERSITY COLLEGE, LONDON, at 5.—Dr. H. R. Ing: "Chemical Structure and Pharmacological Action" (succeeding lectures on Feb. 20, 27, March 6, 13 and 20).

UNIVERSITY OF LEEDS, at 5.15.—Prof. J. Barcroft: "The Evolution of the Body as a Milieu Adequate for the Mind".

INSTITUTION OF ELECTRICAL ENGINEERS (MERSEY AND NORTH WALES CENTRE), at 7.30—(Faraday Lecture at the Central Hall, Renshaw Street, Liverpool).—Prof. J. T. MacGregor-Morris: "Lightning, and how the Engineer deals with its Effects" (to be repeated before other Sections).

Tuesday, Feb. 14

ROYAL INSTITUTION, at 5.15.—Sir William Bragg: "The Analysis of Crystal Structure by X-Rays: A Review of the Work of Twenty Years" (succeeding lectures on Feb. 21, 28 and March 7).

PHARMACEUTICAL SOCIETY OF GREAT BRITAIN, at 8.30.—Prof. J. A. Gunn: "The Search for New Remedies".

Wednesday, Feb. 15

ROYAL METEOROLOGICAL SOCIETY, at 5.15—(Presidential Address).—Prof. S. Chapman: "Atoms, Molecules and Atmosphere".

UNIVERSITY COLLEGE, LONDON, at 5.30.—I. C. Gröndahl: "Oslo and its Environs" (succeeding lectures on Feb. 22 and March 1).

UNIVERSITY COLLEGE, LONDON, at 5.30.—J. Ross: "The Work of the Bristol Public Library".

ROYAL SOCIETY OF ARTS, at 8.—Capt. Harold K. Salvesen: "Modern Whaling in the Antarctic" (Film).

Thursday, Feb. 16

UNIVERSITY OF LONDON, at 5—(at the London School of Economics).—A. W. Street: "The Marketing of Agricultural Produce" (succeeding lecture on Feb. 23).

LONDON MATHEMATICAL SOCIETY, at 5.—Prof. P. A. M. Dirac: "The Relation between Classical and Quantum Mechanics".

ROYAL INSTITUTION, at 5.15.—A. R. Hinks: "Geography in the Public Service" (succeeding lectures on Feb. 23, March 2 and 9).

CHEMICAL SOCIETY, at 8.—Discussion on "The Raman Effect in Relation to some Chemical Problems", to be opened by Dr. J. J. Fox.

LINNEAN SOCIETY—(Hooker Lecture).—Sir William Wright Smith.

Friday, Feb. 17

INSTITUTION OF CHEMICAL ENGINEERS, at 11.—Eleventh Annual Corporate Meeting. At 11.45, The Right Hon. the Viscount Leverhulme: "Chemical Engineering and the Soap Industry".

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—(Annual General Meeting).

INSTITUTION OF MECHANICAL ENGINEERS, at 5.30—(Annual General Meeting).—F. R. B. Watson: "The Production of a Vacuum in an Air Tank by Means of a Steam Jet".

Saturday, Feb. 18

ROYAL INSTITUTION, at 3.—Lord Rutherford: "Detection and Production of Swift Particles".

Official Publications Received

GREAT BRITAIN AND IRELAND

Empire Cotton Growing Corporation. Report of the Executive Committee to be submitted to the Meeting of the Administrative Council on January 17th, 1933. Pp. 8. (London.)

The British Chemical Plant Manufacturers' Association. Official Directory of Members, 1933: with a Classified List of their Manufacturers and Services. Pp. 174. (London.) Free.

British Chemicals and their Manufacturers: the Official Directory of the Association of British Chemical Manufacturers (Incorporated). Pp. 430. (London.) Free.

The Scientific Proceedings of the Royal Dublin Society. Vol. 20 (N.S.), No. 32: An Investigation of the Behaviour of Neon Discharge Tubes in a Flashing Capacity Circuit by means of a Cathode Ray Oscillograph. By Dr. J. H. J. Poole. Pp. 477-486+plate 44. 1s. Vol. 20 (N.S.), No. 33: Bast-Sap. By Prof. Henry H. Dixon. Pp. 487-494+plate 45. 1s. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.)

Journal of the Society for the Preservation of the Fauna of the Empire. New Series, Part 18, January. Pp. 61. (Hertford: Stephen Austin and Sons, Ltd.) 2s.

Memoirs of the Cotton Research Station, Trinidad. Series A: Genetics, No. 4: The Inheritance of Anthocyanin Pigmentation in Asiatic Cottons. By J. B. Hutchinson. Pp. 317-339+plates 25-26. (London: Empire Cotton Growing Corporation.) 2s. 6d.

Scottish Marine Biological Association. Annual Report, 1931-32. Pp. 24. (Glasgow.)

Proceedings of the Royal Society of Edinburgh, Session 1932-1933. Vol. 53, Part 1, No. 1: On the Development of the Olfactory Organ in *Protopterus*. By Margaret H. Fullerton. Pp. 6. 9d. Vol. 53, Part 1, No. 2: A Matrix Notation for Mendelian Populations. By Prof. Lancelot Hogben. Pp. 7-25. 1s. 6d. Vol. 53, Part 1, No. 3: Supernumerary Pectoral Fins in *Raia circularis* London. By Dr. W. F. Harper. Pp. 26-30. 9d. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

Transactions of the Royal Society of Edinburgh. Vol. 57, Part 2, No. 18: A Study of the Foliar Endodermis in the Plantaginaceae. By George Trapp. Pp. 523-546. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.) 3s.

OTHER COUNTRIES

Proceedings of the Imperial Academy. Vol. 8, No. 9, November. Pp. xxv-xxvii+407-473. (Tokyo.)

Journal of the Faculty of Agriculture, Hokkaido Imperial University. Vol. 33, Part 2: H. Sauter's Formosa-Ausbeute—Ichnemonidae (Hym.). By Toichi Uchida. Pp. 133-222. (Tokyo: Maruzen Co., Ltd.)

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 89: Measurements of the Solid Viscosities of Metals through the Flexural Vibrations of a Bar. By Katsutada Sezawa and Kei Kubo. Pp. 195-231. (Tôkyô: Koseikai Publishing House.) 45 sen.

The Journal of Chemical Physics. Vol. 1, No. 1, January. Pp. 128. Lancaster, Pa., and New York: American Institute of Physics.) 1.25 dollars.

Bulletin of the American Museum of Natural History. Vol. 63, Art. 5: Herpetological Results of the Whitney South Sea Expedition, 6: Pacific Island Amphibians and Reptiles in the Collection of the American Museum of Natural History. By Charles E. Burt and May Danheim Burt. Pp. 461-597. Vol. 65: The Birds of the Belgian Congo, Part 1. By James P. Chapin. Pp. x+756+11 plates. (New York City.)

Publications de l'Observatoire Astronomique de l'Université de Belgrade. Tome 5: Annuaire pour l'an 1933. Rédigé par V. V. Michkovitch. Pp. 110. (Beograd.)

Report on the Administration of the Meteorological Department of the Government of India in 1931-32. Pp. ii+34. (Calcutta: Government of India Central Publication Branch.) 8 annas; 10d.

Library of Congress. Report of the Librarian of Congress for the Fiscal Year ending June 30th, 1932. Pp. vi+343+11 plates. (Washington, D.C.: Government Printing Office.)

Conseil Permanent International pour l'Exploration de la Mer. Rapports et procès-verbaux des réunions, Vol. 80: The Effect upon the Stock of Fish of the Capture of Undersized Fish; Reports of the Proceedings of a Special Meeting held on June 24th, 1932, at Copenhagen. Pp. iv+88. (Copenhagen: Andr. Fred. Høst & fils.) 3.75 kr.

Report of the Department of Industries, Madras, for the Year ending 31st March 1932. Pp. 71. (Madras: Government Press.) 8 annas.

The Science Reports of the Tôhoku Imperial University, Sendai, Japan. First Series (Mathematics, Physics, Chemistry). Vol. 21, No. 4, December. Pp. 455-725. (Tokyo and Sendai: Maruzen Co., Ltd.)

Memoirs of the College of Science, Kyoto Imperial University. Series A, Vol. 15, No. 6, November. Pp. 351-372. (Tokyo and Sendai: Maruzen Co., Ltd.) 90 sen.

Science Reports of the Tokyo Bunrika Daigaku. Section B, No. 4: Notes on some Rare Materials of Japanese Oxyrhyncha. By Tsune Sakai. Pp. 41-59+3 plates. 26 sen. Section B, Nos. 5-10: Studies on Amphibian Chromosomes, 4, On the Chromosomes of *Rana rugosa* and *Rana nigromaculata*, by Shigemori Iriki; Studies on Amphibian Chromosomes, 5, Explanation of the Sex-Chromosomes Type of *Hyla arborea japonica* from the Standpoint of Spiral Structure, by Shigemori Iriki; Studies on Amphibian Chromosomes, 6, On the Chromosomes of *Diemyctylus pyrrhogaster*, by Shigemori Iriki; Studies on Amphibian Chromosomes, 7, On the Chromosomes of *Megalobatrachus japonicus*, by Shigemori Iriki; Studies on Amphibian Chromosomes, 8, On the Fixation of the Chromosomes of *Hyla arborea japonica* and some other Animals, by Shigemori Iriki; Studies on the Chromosomes of Pisces—On the Chromosomes of *Aplocheilichthys latipes*, by Shigemori Iriki. Pp. 61-131+plates 4-12. (Tokyo: Maruzen Co., Ltd.) 1.05 yen.