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Professional Organisation

IN the problems which must be faced in establishing the right relations between knowledge and power, upon which the future of civilisation depends, those concerned with professionalism cannot be neglected. They are in fact part and parcel of the problems which have been created by the work of the engineer and thus indirectly by the coming of science, and a concatenation of circumstances is bringing them into prominence at the present time.

In the first place, professional associations directed towards the acquisition and publication of new knowledge—what may be generally termed study or research activities—are finding it more and more difficult to sustain the burden of publication. This may be seen in the movement in Great Britain for closer co-operation among the various societies concerned with chemistry, and in the plea considered last year by the Committee on New Industrial Development that the Government should undertake the responsibility of preparing abstracts of scientific literature. In the second place, those which have been chiefly concerned with maintaining or raising the status of the scientific professions, and more particularly with improving the economic position of the members, are being forced to take much wider views than were at one time prevalent in such matters as registration of the profession.

Simultaneously with a keener scrutiny of professional problems from within, the external influence of the professions is undoubtedly extending. The value of the scientific expert in national, and indeed in international, affairs has already been demonstrated conclusively. With the increase in the size of industrial and commercial units there is a growth in the importance of the duties which fall to those occupying the higher salaried posts, as well as a definite tendency for those occupying the more important positions to come within professional associations or at least under professional influence. The possession and application of an intellectual technique, acquired as the result of prolonged and specialised training, are becoming the characteristic of those occupying such posts as they are of the professions; and the incompatibility of profit-making with professionalism is ceasing to be an obstacle to the spread of professionalism through the business world. These tendencies, which accentuate the importance of professionalism in

the future society and the dangers attending neglect of the related problems, are also encouraging the consideration of such problems in a much broader way.

An analysis of the problems involved in the closure of a profession by registration suggests indeed that this is by no means as satisfactory a method of raising the status of a profession as is often imagined, and is indeed far from being a universal panacea for all professional ills. Its efficacy depends largely upon the nature of the service rendered by the profession and the directness of the relations between its members and the general public. Even when the service is vital, fiduciary or intimately related with public safety, the protection of a title is a clumsy and ineffective way of discouraging practice by the unqualified. Apart from this, if a professional association forms a part of the mechanism of registration, it becomes an organ of the State, and however powerful it may be, it loses some of its freedom. When the professional association is not used in this way, it can no longer take effective action in relation to admission to and expulsion from the profession; accordingly its objects become restricted to the protection of the material interests of its members and to public activities and study functions, although of course an important indirect influence may be exerted on professional education and ethics.

Such reasons as these induce some to regard the grant of a Royal Charter to a professional association as a more satisfactory and hopeful means of achieving its objects than registration, and this view is undoubtedly supported by the fact that the valuable measures of control over professional associations which the Privy Council is able to exercise in return for the grant of privilege have not as yet been fully used. It would, for example, be a simple matter for the Privy Council to influence the educational policy of professional associations, to bring the system of entry to the professions controlled by chartered bodies into line with its policy for registered professions; to press for a multi-portal system, for institutional training and for adequate supervision of practical training.

When the professional field is surveyed as a whole, we cannot fail to be impressed with the educational aspects as holding the key to the situation. While the growing complexity of modern life demands increasing specialisation, the very specialisation evolved to meet the need is apt to

breed a narrowness of outlook which makes integration of a whole situation difficult. The demand for vision, for the capacity to co-operate, has increased simultaneously with the need for intense specialisation. At the same time the specialisation of technique tends to encourage premature and excessive specialisation during the period of training for professional life. Yet the professional man, having one foot in the academic world and the other in the world of affairs, is in a position to discover what is possible and to make it known and thus to render a unique service to public policy. The whole of the tendencies to which we have just alluded are, however, making it more and more difficult for the professional man to render just this indispensable service.

The part which the professional man is called upon to play in the society of to-day thus involves more than mere technical competence. He should be an educated man in the broad sense of the term, if he is to play his proper part in the application of his technique to the needs of society. In maintaining a high standard of professional efficiency, the associations concerned could at least have greater regard to the factor of general education, put greater restrictions on early specialisation and endeavour to secure that specialised training when it comes is not given in a narrow atmosphere. It is here that professional training within the universities possesses an outstanding advantage. Within such a course of scientific study, technical accomplishments can be integrated and acquired as part of the wider training, and training alongside those preparing for different professions is one of the most hopeful ways of overcoming the disadvantages of inevitable specialisation.

There is, however, an obvious danger in professional examinations which should not be overlooked. When all entrants to a profession have to pass the same examination, all will follow similar courses and professional training will be characterised by a uniformity which accentuates the ill effects of specialisation. A species of intellectual inbreeding and sterilisation is only too apt to follow, and on this ground alone the multi-portal system of entry to the professions has much to commend it.

The surest antidote to these dangers is, however, the spirit of service on which professional life is essentially based. A keen sense of vocation may be relied upon to keep a profession from becoming too conservative and unresponsive to changes in

the needs which it was originally called into being to serve, and to supply the wider vision which can avert the evils of excessive specialisation.

The obvious need for the fullest and most efficient use of professional technique in the service of the community should undoubtedly slowly intensify the spirit of service and vocation in the professional community. Co-operation is urgently needed to-day on the part of professional men of mature experience in the working out of the methods by which the special contribution of the professions to the service of the State should be made—how their advice should be presented and utilised. With a clear vision of social and national service and an understanding of the fundamental purposes of professional associations, professional men, and above all scientific workers, might not only use their associations for the improvement of their own technique and status but could also shape those organisations into effective instruments for the service of the wider needs of society.

General Science in Schools

THE final report of the committee appointed by Section L (Educational Science) of the British Association to inquire into the teaching of general science, with special reference to the teaching of biology, in schools, was presented at the recent meeting at Leicester. It contains a historical survey of previous reports on the teaching of science; an analysis of replies from 358 schools to a questionnaire by the committee; discussions and suggestions regarding examinations and the place of out-of-school activities in relation to science; and a summary of the present position and of the suggestions approved by the committee.

The report, without being unduly optimistic, is certainly encouraging; for it makes clear that general science in the broader sense, that is, including biology as well as chemistry and physics, is becoming increasingly popular in schools; and that the fusion between botany and zoology into the one subject biology is extending further. But it is to be hoped that these tendencies in the right direction will make yet further headway, and that the broader general science will before long become universal in the years before the school certificate examination. At present, only 25 per cent of the boys', 41 per cent of the girls', and 32 per cent of mixed schools take biology; and the percentages of pupils taking biology in these are 21, 26 and 28

respectively. It would thus seem that even in these schools, biology is included during a portion only of the school career, and not throughout it; and it is clear that neither general science (including biology) nor biology itself as a separate subject, is taught as much as the other scientific subjects.

The reasons assigned for the absence of biology are chiefly: (1) the requirements of some school certificate examinations; (2) lack of suitable teachers; (3) lack of suitable accommodation. The report shows, however, that, speaking broadly and excepting a few dissentients and a few 'sitters-on-the-fence', the schools are alive to the educational value of biology, but are confronted by obstacles which at present they do not see their way to overcome. Probably the most serious of these obstacles is the non-acceptance for matriculation, by most universities, of general science, including biology, in the school certificate examination. Where, as is the case at some universities, candidates can take chemistry and physics in this examination, both being accepted for matriculation, it is almost certain that schools will teach these two subjects, and will not teach biology. If all universities (and those professional bodies which do not accept general science as a qualifying subject in the preliminary examination) would fall into line and agree to accept general science including biology, the road would become easier for many schools.

Among the objections to general science quoted in the report is the statement that it is scarcely possible to obtain science scholarships unless specialisation in physics and chemistry begins at fourteen years of age. To begin at this early age to "learn more and more about less and less" is educationally criminal. Protest has already been made against the excessively high standard of scholarship papers in these two subjects; and it is to be hoped that lowering that standard will render it not only possible but also profitable for all candidates to have taken general science, including biology, in the school certificate examination before proceeding to specialise in any subject.

It is satisfactory to note that it is becoming more possible for boys, both younger and elder, to take part in out-of-school activities other than organised games. Natural history clubs and science societies are valuable allies to the class-room and laboratory, especially the biological, and afford opportunity for the development and spontaneous manifestation of the true scientific spirit of research.

The Counters of Wise Men*

By DR. ALLAN FERGUSON

“HE began his task (as he himself expressly described to me) by devoting his first care to a diligent perusal of all such English writers as were most correct in their language, and under every sentence which he meant to quote he drew a line and noted in the margin the first letter of the word under which it was to occur. He then delivered these books to his clerks who transcribed each sentence on a separate slip of paper, and arranged the same under the word referred to. By these means he collected the several words and their different significations, and, when the whole arrangement was alphabetically formed, he gave the definitions of their meanings and collected their etymologies from Skinner, Junius and other writers upon the subject.”

This is the technique of dictionary-making, as devised by Johnson, and carried out by him a hundred and eighty years ago in the upper chamber of that house in Gough Square which fortunately still remains, one of London's most cherished monuments. The method was simple, the authorities primitive; but the result showed, on occasion, a freedom and vigour of expression which we can scarcely hope to attain in our more sedate age.

The classic definitions of *lexicographer*, “a writer of dictionaries, a *harmless drudge*”; *oats*, “a grain which in England is generally given to horses, but in Scotland supports the people”; *excise*, “a hateful tax levied upon commodities, and adjudged not by the common judges of property, but wretches hired by those to whom excise is paid”; *pension*, “. . . pay given to a state hireling for treason to his country”; these make lively enough reading to-day, even though now, as then, they “cannot be fully defended and must be placed to the account of capricious and humorous indulgence”. Small wonder that the staid Principal Robertson read through the dictionary twice.

The etymologies of Johnson's work may be dated, and its definitions now and then show signs of tiredness—Joseph's flowers, ‘a *plant*’, is a case in point; but, informed as it was with his massive, immense and forceful erudition, it marked an immense advance on the work of his predecessors. N. Bailey *φιλολογος*, and the rest were genially inclined to the loose in definition and the obvious in etymology—Betty from *beatus*, and belfry from *bell* and *ferre*, “that which bears the bell”, are not unfavourable specimens of their genius. To-day we tread on surer ground, even though, unexpectedly, the commonest monosyllables prove to be the most difficult, in the etymological sense. *Floccinaucinihilipilification* yields its secrets to the analysis of a fourth form tyro, while *puss* and *boy* remain tantalisingly obscure in origin.

We have waited long for a worthy English successor to Johnson's dictionary—a successor the possession of which should be within the scope of a modest purse. We have, of course, that great dictionary, king of all lexicons, which, by the circumstances of its birth, has occasioned one of the happiest pieces of nineteenth century Boswelling on record. BOSWELL: “What would you say, sir, if you were told that a successor to your dictionary would be edited in your own University of Oxford by a Scotsman and a Presbyterian?” JOHNSON: “Sir, to be facetious it is not necessary to be indecent.” But the great Oxford dictionary is one which most of us, covet it as we may, must perforce be content to consult in the unsympathetic atmosphere of a public library. Now, in the compass of some two thousand five hundred quarto pages we have, issued at a comparatively modest price, a work which exhibits most of those features which have made the “Oxford” the most famous of all dictionaries.

The qualities which the plain man will seek in this “Shorter Dictionary” are best summarised in the heads of the information given in any one article. The word under consideration, marked when necessary by symbols which indicate something of its status, is followed by the pronunciation and the notation of the part of speech. Then follows a word indicating, if necessary, more detail of its status—*slang*, *dialect*, *colloquial* and so forth. Variant spellings and inflexional forms are next indicated, and then follows one of the most important features of the article, a feature which must have occasioned an immense amount of research—a statement of the earliest appearance of the word, given by means of a precise date if the appearance of the word is later than 1450. Then follow the etymology, the specification of the word as belonging to some art or science, the various meanings, with the date of their first appearance, or if they are obsolete, with the date of their disappearance, illustrative quotations, and groups of idiomatic phrases and usages.

Even this arid specification of the information afforded in each of the scores of thousands of articles which go to make up this “Shorter Dictionary” cannot conceal the immense mass of literary, scientific, artistic and philological information which is brought together in these massive volumes. The most uninspired searcher therein must sense something of the romance of words when he traces, in the matter of fact record, the wanderings of *apricot* from Portuguese *albricoque* through Arabic to Greek *πραικόκιον* adapted from Latin *praecoquum* a variant of *praecox*, and so *the early ripened fruit*. What stories of mutability, of chops and changes of meaning and popularity, are concealed behind the dates which tell us something of a word's birth and death! This, one of the dictionary's most valuable features,

* “The Shorter Oxford English Dictionary on Historical Principles”. Prepared by William Little, H. W. Fowler, J. Coulson. Revised and edited by Dr. C. T. Onions. Vol. 1: A-M. Pp. xxii+1306. Vol. 2: N-Z. Pp. viii+1307-2475. (Oxford: Clarendon Press; London: Oxford University Press, 1933.) 63s. net.

could be made still more valuable by small additions which in the aggregate would not add appreciably to the size of the work. Take a case in point. Some little time ago the problem was posed—at what period did the word *tension*, in the incorrect usage *vapour tension*, enter the literature of science? The “Shorter Dictionary” solves the problem in the entry (*s.v.* *tension*), “Inexactly used for the expansive force of a gas or vapour, properly called *pressure* 1678.” Now, it would be too much to expect to find in a dictionary which, large as it is, is but an epitome, a full reference to the work in which the usage is first exemplified. But is it too much to ask that the name of the *author* of the work in question, may be added in brackets to all such dates? This would increase the volume of the work inappreciably and the name would form a pointer amply exact for those interested in any special word.

On the science side, one or two of the dates given would seem to be later than is warranted by the usage of the word. Thus the noun *resistance* in the sense of “a part of an electrical apparatus used to offer a definite resistance to a current, 1878” is surely dated far too late. The concept and the word are freely scattered through Wheatstone’s Bakerian lecture of 1843, where we find, *ex. gr.*, “in two circuits . . . when the same resistance is introduced, the strength of the two currents may be weakened in very different proportions.” It may be mentioned in passing that Wheatstone, in this lecture, defines and discusses the introduction of terms such as *rheomotor*, *rheometer*, *rheotome*, *rheotrope*, *rheoscope* and *rheostat*. Of these terms only the last-named is in common use to-day. They are all duly tabulated in the dictionary but without any indication of the date of their introduction. Again, the word *Geordie* is entered as “Miner’s name for George Stephenson’s safety lamp 1881”, a date which is surely more than half a century in error. The word has either been noted in some centenary volume (Stephenson was born in 1781), or maybe 1881 is a misprint for 1818. The lamp was invented in 1815, and a description of it under the name *Geordy lamp* is to be found in editions of Smiles’ *Life of Stephenson* published in the ‘fifties of last century.

That the words of our great heritage, our literature, are exhaustively explained, and exemplified by most skilfully chosen illustrative quotations, need scarcely be said. The editor modestly hopes that the dictionary “may be found acceptable as a lexical reading companion to English literature.” It is much more. In this respect it is a treasure-house of English usage the value of which to the reader increases as knowledge of its contents grows. Equally valuable is it in its illustration of colloquial usage. How far one may expect such a dictionary to assist the connoisseur of dialect, of argot, or of slang, is a moot point. Certainly the present dictionary gives far more assistance than one would have expected from a

comparison of its scope with that of the parent dictionary. Would you widen your knowledge of Corinthian or sporting argot, of the cant and slang patter either of St. James’s or St. Giles’s? If you are not awake, or fly, you have little need to take your degrees under the celebrated Captain Grose—the editors are as skilful professors of the flash as ever was Bob Logic. Back-slang is defined and, quite properly, only slightly exemplified—he who would know the back slang for *hippopotamus*, may excogitate *summatopoppy* for himself; but it is odd to find Winchester *notions* unnoted. In the matter of dialect the present writer was *glopped* to see that his own dialect of Lancashire was well represented by many common, rare and obsolescent words—even though some of those words were lacking which, living in the songs of Waugh, Brierley and Laycock, have become part and parcel of northern literature. These omissions are striking in the Scots dialect. We must be grateful to the editors for giving us what they have done—the Southron, fortified with this dictionary, may read his Scott with as much ease and pleasure as his fundamental ignorance of the language will permit—this dictionary will find for him the equivalent of most of Scott’s dialect speech.

Surely, however, Burns deserves similar consideration; every word that he wrote should be found and explained in a dictionary which admits so many and so varied words in Lowland Scots as are to be found in the “Shorter Dictionary”. We should scarcely expect the dictionary to give a great deal of assistance in the deciphering of that letter written by George Outram in 1844, inviting critics of the Treaty of Union with England to a once-famous dinner at which they might discuss the “cassin o’ the wanchancie Covenant”, and, the better to do so should “subsist upon our ain national vivers allenarlie, and sae pruiwe how far we can forega the aids o’ foreign countries in respect of our creature comforts, . . . whiles pangin oursels wi’ haggis and brose, an’ whiles wi’ sheep’s head an’ partan pies, rizzard haddies, crappit heads an’ scate-rumples, nowtes’ feet, kebbucks, scadlips, an’ skink, forbye custocks, carlings, rifarts an’ syboes, farls, fadges an’ bannocks, drammock, brochan an’ powsowdie an’ siklike—washin’ the same doun our craigs wi’ nae foreign pushion—but anerlie wi’ our ain reamin yill an’ bellin usquebaugh.” Here, indeed, the dictionary gives more help than we could hope for, elucidating, as it does, some two-thirds of the dialect words in this passage.

But the Doric of Burns is literature; it is not esoteric and his Southron readers have just cause for a mild grumble when they find

“Ye Maukins, cock your fud fu’ brow,”

duly explained, and

“If on a beastie I can speel
Or hurl in a cartie”

left hidden in a Scottish mist.

Why, in

"She tauld thee weel thou wast a skellum
A bletherin', blusterin' drunken blellum,"

should *skellum* be explained, and *blellum* left?

Perhaps these insertions and omissions are determined by considerations of etymological interest, and it is assumed that, for the mere purpose of translation, the English reader must equip himself with an edition of Burns which boasts a glossary.

It must, however, be emphasised that these omissions are relatively of very small importance, and indeed they are to some extent matters of taste which may well be left to the judgment of the editor. To readers of NATURE the assistance that the dictionary affords in elucidating and dating scientific terms is a matter of very special interest and here we have to chronicle a number of very curious omissions which indicate that the dictionary is some years behind the science of the twentieth century. To direct attention to omissions is a thankless task; it tends to discount in the reader's mind the gratitude which the critic feels for the impressive amount of positive scientific information which the dictionary certainly does furnish; and I can only say that I have endeavoured, in selecting what can be, at best, but a few samples, to make my sampling process as fair as may be. The scientific terms of the science of the nineteenth century (and earlier) are analysed and dated with impressive and exact scholarship; but there are a number of important omissions to be chronicled when we come to deal with the events of the last quarter of a century or so. Maybe this is in the nature of the case; for it is obviously difficult to keep up to date all parts of an immense work which has to be set up in alphabetical order.

Another clue to these omissions may be found in the fact, chronicled in the preface, that Mr. Wm. Little, who was originally responsible for the abridgment, worked on it steadily from 1903 until his death in 1922, when "he had prepared entirely without assistance the manuscript for the letters A to T and V, and had passed for printing about one-third of the whole dictionary." Much has happened since 1922.

Let us make a few tests, giving to the results of our search neither more nor less weight than such a restricted sampling merits. We shall seek neither recondite nor highly-specialised terms, but confine our attention to words and phrases which have been lately in common use. *Resistance*, as we have seen, is present. *Induction*, and derived phrases, are illustrated very completely; *inductance*, *capacity* and *capacitance* (all in the electrical sense) are absent. *Proton* is present, and wrongly defined as "the positive charge of an atom"; *photon* and *alpha-particle* are missing. *Specific*, *atomic* and *molecular heats* are defined; *specific inductive capacity* is omitted. The introduction of the word *relativity* is referred to 1919, and the dictionary

apparently knows no distinction between *special* and *general relativity*. Despite the fact that a journal of *rheology* has been in circulation for some years, the word finds no mention here. *Choke-* or *choking-coils* are unknown. *Ampère*, *Ohm*, *Coulomb* and *Gauss*, as giving their names to well-known units, are represented; *Maxwell*, *Gilbert* and *Oersted* are not. In photometry the *lumen* is defined; the *lux* is not. *Quantum* is defined; allied words in common use, such as *quantize* and *quantization*, are not entered. The dictionary is rich in brief phrases—*periodic law*, for example, is carefully defined; we search in vain for *correspondence principle*, *uncertainty principle* and *exclusion principle*. *Virial* and *ergal*, the bounding brothers of Bonn, are represented by *virial*, bereft of his twin.

In the biological sciences, such important words as *gene*, *zymase*, and—most remarkable of all—*enzyme*, are left unmentioned. In the science of psychology, while *psycho-analysis* is clearly defined, *sublimation*, in its strict psychological sense, is unnoticed, as is *super-ego*; *id* is defined in its biological sense, receiving no notice as a psychological term. We are introduced to old *buffers* and to railway *buffers*, but a *buffer solution* is left unexplained, and the reader who seeks an explanation of the mystic term *pH*, may seek in vain. *Solute*, as a noun substantive, is overlooked. The general reader might reasonably expect to find *holism* defined—Smuts's book was published seven years ago—but the word is absent. Discoveries associated with the names of the discoverer are apparently entered under the heading of the common noun. Thus under *law* we find Avogadro's Law, Boyle's Law, Charles' Law and so forth mentioned, but not quantitatively defined. The practice is apparently not consistent. Under *Joule* we find a cross-reference to *equivalent*, and there we find *mechanical equivalent of heat* quantitatively defined, without any reference to Joule. *Young's modulus*, surely as important and as common-place as Joule's equivalent, finds no mention here; neither does *Planck's constant*. It would immensely enhance the value of the dictionary to the student were such phrases entered as articles under the names of their discoverers, defined quantitatively and dated.

Most technical terms have to-day passed into print in some form or other. We can scarcely say, as Johnson did, that "I could not visit caverns to learn the miner's language, nor take a voyage to perfect my skill in the dialect of navigation, nor visit the warehouses of merchants, and shops of artificers to gain the names of wares, tools and operations, of which no mention is found in books; what favourable accident, or easy inquiry brought within my reach, has not been neglected; but it had been a hopeless labour to glean up words, by courting living information, and contesting with the sullenness of one, and the roughness of another." Even so, there are many scientific and technical terms so specialised in use, that it would be most undesirable to attempt to include

them in a dictionary designed for everyday use. Still, the terms on omission of which we have commented are important and in common use, and it is deeply to be desired that in future editions this side of the dictionary will be thoroughly overhauled.

The value of this dictionary is not to be gauged in terms of the three guineas of its price. *Words are the counters of wise men and the money of fools*; and the world would be saved much trouble and strife if its inhabitants were only more skilled in the use of these counters. To the increase of that skill our new dictionary is destined to contribute even more largely than the parent lexicon,

and the perfecting of this instrument, already most valuable, is a matter of immediate concern to all. Such alterations and additions as may be necessary to be made deal merely with matters of detail; and even as a Lover of the Arts said of that Compleat Dictionary printed at Cambridge by John Field in 1667, so we may heartily recommend this product of twentieth century erudition to "*those vertuous and well-addicted Persons who . . . have here a volume fit for their purpose, as carefully designed for their assistance: and to such, and onely such, we recommend it, and that with this Benediction, Live long, industrious Reader, advance in Knowledge, and be happy.*"

Deep-Sea Angler Fishes

THERE still remains a large field for the discovery of new forms of animal life in the deeper layers of the ocean water masses. There, pelagic life is not concentrated at one level, but has a vertical range of many hundreds of metres in which to roam as well as thousands of square miles horizontally. The larger animals thus tend to become comparatively sparsely distributed. To sample this deep-living population, great quantities of water must be filtered, and it is only to be expected that the recent introduction of large pelagic nets would bring a considerable extension to our knowledge. Perhaps nowhere is this better emphasised than in the study of the deep-sea angler fishes of the sub-order Ceratioidea; as a result of the examination of the collection of these fishes made on the world voyage of the *Dana* in 1928-30 under the late Prof. Johannes Schmidt, our knowledge has been amplified and brought up to date by Dr. C. Tate Regan and Miss Ethelwynn Trewavas*.

Although a systematic revision of the group was made by Dr. Tate Regan in 1926, the addition of new species and collection of new specimens has been so great that the authors have found it necessary to make a further revision. In the former report the number of species was 60 while now 158 species are recognised. Previous collections had consisted, to a considerable extent, of specimens less than one inch in length which had been assigned to those known species which they most nearly resembled; it is now shown that, among the Oneirodidæ, the adult characters may be assumed at a very small size.

The Ceratioids have recently become known in the zoological world on account of the discovery, on the females of certain species, of dwarfed parasitic males the bodies of which had become fused to that of the female at an early stage. This was known in the four families, Ceratias, Photocorynus, Edriolychnus, and Caulophryne. The same habit has now been shown to occur also in the families Borophryne and

Linophryne; the authors also say that the continuity of the blood systems of the male and female has been proved in Edriolychnus.

As only females of the solitary adult type had been found in previous collections, it was thought that perhaps the habit of parasitisation by the males was of general occurrence throughout the sub-order. In 1930, however, Parr recorded the discovery of a free-living male (*Rhyncoceratias longipinnis*) with a well-developed testis. In the report before us it is now shown also that the males are not parasitic in the Melanocetidæ, Himantolophidæ, and Oneirodidæ. They are small free-swimming fish which show considerable structural differences from the females. They have no illicium, have large olfactory organs, and except in two naked species, the skin is spinulose.

Typically the female ceratioids have large mouths, strong teeth and very distensible stomachs; they are solitary and inactive and by means of their luminous lures (the illicium) they attract prey often larger than themselves. The males have small mouths and stomachs and probably swim actively in search of their prey and of their mates. It is thought that the females most nearly retain the structure and habits of the original members of the group, since they possess the illicium so characteristic of angler fishes. They appear normally to inhabit the layers of the ocean at 500-2000 m. depth and are most abundant in warmer parts of the ocean. The comparison of ceratioids from the Panama region with those of other regions of the Pacific needs further study.

A section of the report is devoted to the osteology and classification of the sub-order. The most important structures for diagnosing the families are, the structure of the fins, form of the hyomandibular, number of branchiostegals, number of pectoral radials, and presence or absence of pelvic bones. The last and greater part of the report is taken up with the systematic revision. The volume contains also ten plates of illustrations of 22 species by Lieut.-Col. W. P. C. Tenison, which emphasise how effective stippling can be in the representation of solid form, where the expense of reproduction of wash drawing seems unnecessary. F. S. R.

* The Carlsberg Foundation's Oceanographical Expedition round the World, 1928-30. Report No. 2: Deep-Sea Angler-Fishes (*Ceratioidea*). By Dr. C. Tate Regan and Ethelwynn Trewavas. (Published by the Carlsberg Foundation.) Pp. 113+10 plates. (Copenhagen: C. A. Reitzels Forlag; London: Oxford University Press, 1932.) 15s. net.

Heavy Hydrogen and Heavy Water

THE mass of the hydrogen atom, 1.00778 ± 0.00015 , found by Aston with the mass-spectrograph, appeared to be in very satisfactory agreement with the chemical atomic weight, which is one of the most accurately determined (A. Scott; Morley; Burt and Edgar). The discovery of the isotopes of oxygen, however, made it clear that the values found by the mass-spectrograph were referred to the oxygen isotope $O^{16} = 16.000$, whilst the chemical values were referred to the isotopic mixture $O = 16.000$. The factor for the conversion of mass-spectrograph values to chemical values now generally accepted is based on the spectroscopic abundance ratio $O^{16} : O^{18}$ determined by Mecke and Child¹, and Aston's value on the chemical standard then becomes 1.00756 , which is certainly too low for the mass of the ordinary hydrogen atom.

Birge and Menzel² thereupon suggested that ordinary hydrogen contains a small amount of a heavier isotope, H^2 , of mass approximately double that of the lighter isotope, H^1 , and that only the latter was noticed in Aston's measurements. In order to reconcile the latter with the chemical atomic weights, an abundance ratio H^1/H^2 of 4,500 in ordinary hydrogen is required. It may be said at once that, although the presence of the isotope H^2 has been firmly established, it is present in very much smaller amount than this calculation suggests, say $H^1/H^2 = 30,000 \pm 20$ per cent³, and that the discrepancy between the mass-spectrograph and chemical values of the atomic weight still remains.

The presence of H^2 in ordinary hydrogen was proved by Urey, Brickwedde and Murphy⁴, who examined the optical spectrum of samples from the residues of the evaporation of liquid hydrogen and found faint lines at the calculated positions for H^2 . The broad $H^2\alpha$ doublet was resolved and the separation agreed with theory. The relative abundance ratio H^1/H^2 was calculated as 4,000, which would explain very nicely the discrepancy just noted, but this result has since been shown to be incorrect. The isotope effect was also found in the Lyman series of hydrogen produced by a discharge in the vapour of 'heavy' water⁵.

The presence of H^2 was then demonstrated by means of the mass-spectrograph by Bainbridge⁶, who found the atomic mass 2.01351 ± 0.00006 relative to He and 2.01351 ± 0.00018 relative to O^{16} , the equivalent packing fraction being 0.675 per cent. Mass-spectrograph evidence for H^2 was also found by Kallmann and Lazareff⁷. Grace⁸ calculated theoretically the atomic weight $H^2 = 2.0113 \pm 0.0012$.

The nucleus of H^2 , at first regarded as an association of two protons and one electron (p_2e), might clearly play an important part in the composition of nuclear structure⁹. The discovery of

the neutron and the positron (positive electron) has given alternative possible structures for the nucleus of H^2 (which has been called the deuteron or deuton); for example, it may consist of two neutrons, conceived as primary uncharged particles of mass 1, and one positron. The proton, on this scheme, loses its supposed fundamental character as a constituent of atomic nuclei, and becomes an association of a neutron and a positron¹⁰.

A partial separation of the isotopes H^1 and H^2 was achieved by E. W. Washburn and Urey¹¹, who examined the water from commercial electrolytic cells which had been operating two to three years. An examination of the optical spectrum of the hydrogen from this water showed an increase in the abundance of H^2 . The oxygen from this water was combined with nitrogen and the nitric oxide spectrum examined. This showed that there was a decrease in the O^{18} isotope concentration of about 8 per cent. The ratio H^1/H^2 in natural terrestrial hydrogen might depend on the particular sample examined, since there might have been some separation in the method used in preparing the hydrogen. It has also been found that H^2 tends to 'clean up' in a discharge tube¹², so that estimates of relative abundance based on optical emission spectra may well be erroneous. A marked increase in specific gravity, freezing point and boiling point, and a decrease in refractive index of water which had undergone prolonged electrolysis, were found¹³.

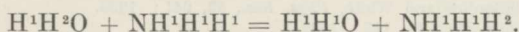
Lewis and Macdonald started with twenty litres of water from an old electrolytic cell, which was half-normal in alkali, and electrolysed it between nickel electrodes with 250 amp. until the volume was reduced by ninety per cent. One tenth was neutralised with carbon dioxide and the rest distilled. The two portions were recombined. The process was repeated until the volume had been reduced to half a cubic centimetre, the electrolysis being conducted below 35° , and preferably near 0° , in order to minimise loss by evaporation, and the current being reduced as the volume of liquid diminished. A difference in cathodic polarisation of 0.04 volt between H^1 and H^2 is reported. There was no accumulation of the heavy isotope of oxygen, O^{18} . As a final result, water of specific gravity 1.073, estimated to contain 65.7 per cent of the hydrogen as H^2 , was obtained. The relative losses of H^1 and H^2 were five to one, and a further reduction to one quarter of the final volume on electrolysis, it was supposed, would give water containing 99 per cent of its hydrogen as H^2 . The estimate of the concentration of H^2 in ordinary water as 1 in 6,500 given in this paper is too high.

Newell and Ficklen¹⁴ examined the specific gravity of water from chromium plating baths which had been operating for periods up to three

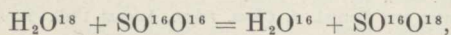
years: specimens from nine baths had specific gravities varying from 1.00002 to 1.00064.

When water is distilled through a fractionating column, a large separation of the isotopes of hydrogen and oxygen can be effected, especially if the distillation is carried out under reduced pressure¹⁵. A 20-ft. column was used and in two modes of operation: (i) the ordinary isotopic composition was maintained at the foot of the still, when a stationary state was reached after two days, the water at the head showing a diminished density of 60 parts in a million; and (ii) the ordinary isotopic composition was maintained at the head of the column and samples were taken daily from the foot, when the density rose by 70–80 parts per million above that of ordinary water. Although the heavy water has an appreciably lower vapour pressure than common water, the differences are rather illusory in connexion with separation by distillation, since there is an exchange of H¹ and H² atoms among the water molecules, and an appropriate calculation shows that it is not the vapour pressure itself but its square root which is proportional to the atomic fraction. Distillation under reduced pressure should be more effective. A large still in operation for two months has shown a steady increase in density of the water at the bottom of the still¹⁶.

The method used by G. N. Lewis and Macdonald¹⁷ in separating the hydrogen and oxygen of a given sample of water, and thus determining how much of the increase in density is due to H² and how much to O¹⁸, depends on passing the steam over heated iron. This is cumbersome, and Lewis¹⁸ has devised a method depending upon the exchange of isotopes in aqueous solution, as in the reaction with ammonia on water:



Ammonia in water may be regarded as forming ammonium hydroxide, NH₄OH, and again dehydrating, the two changes proceeding with great velocity, and as the fourth hydrogen of the ammonium group is exactly like the others, each hydrogen has an equal chance of being lost on dehydration. A rapid interchange of such hydrogen isotope as is present will give a nearly random distribution between NH₃ and H₂O. One mol of water at 0° absorbs nearly one mol of NH₃, and since ammonia has three hydrogen atoms, more than half the H² in the system will escape when the ammonia is pumped off. A sample from the still with an excess density over ordinary water of 0.000182 was saturated with ammonia at 0° and the ammonia pumped off at room temperature. After six repetitions of the process, the water had an excess density of 0.000085, so that at least 0.000097 of the original density excess was due to H². Another experiment consisted in using sulphur dioxide instead of ammonia:



when the density excess was reduced to 0.000109, so that 0.000073 at least of the original excess was due to O¹⁸. In this crude experiment, 0.000170 of the 0.000182 is accounted for.

In precision work the isotopic composition of the ammonia will have to be found, particularly if it has been prepared from electrolytic hydrogen, and precautions must be taken against any large loss of water by evaporation.

It is interesting to note that Holmboe¹⁹ has reported that electrolytic hydrogen is more active in ammonia synthesis than other equally pure hydrogen obtained by reduction of steam by iron: the velocity of reaction was 10–40 per cent greater with electrolytic hydrogen.

An alternative method of separation of H² from electrolytic hydrogen is suggested by experiments by Bleakney, Gould and Taylor²⁰, who report that an enrichment in H¹H² occurs when the gas is progressively removed from charcoal on which it has been adsorbed, in agreement with some theoretical results of Eyring.

Practically pure 'heavy water', H₂O, was obtained by Lewis and Macdonald²¹, whose experiments on its physical properties were carried out with 0.12 c.c. of liquid in which the proportion of H¹ isotope was probably not greater than 0.01 per cent. The freezing point was found to be +3.8° and the boiling point 101.42°. The vapour pressure curve was established and the following values for the ratio p_2/p_1 , where p_1 is the vapour pressure of ordinary water and p_2 that of heavy water, were found:

t°C.	20	30	40	50	60	70	80	90	100	110
p_2/p_1	0.87	0.88	0.89	0.90	0.913	0.923	0.933	0.942	0.949	0.956

The usual calculation shows that the latent heat of evaporation is greater than that of ordinary water by 259 ± 3 or 4 gm. cal. per mol. The density at 25° was found to be 1.1056 and the temperature of maximum density +11.6°. The values of $vol./(vol. \text{ at } 4^\circ)$ were as follows:

t°C.	5	10	15	20	25	30	35	40
V_4^t	0.99987	0.99948	0.99958	1.00016	1.0011	1.00243	1.00415	1.00605

In the various respects in which water is said to be an abnormal liquid, heavy water (H₂O) seems to be more abnormal, but the difference between the two becomes smaller with rising temperature.

Several miscellaneous investigations on H² and H₂O have recently been reported. The nuclear spin²² of H² is (by exclusion) probably 2/2, or twice that of H¹; the emission spectrum of hydrogen with 25 per cent H¹H¹, 50 per cent H¹H² and 25 per cent H²H², and the electronic band spectrum due to neutral OH², have been examined^{22, 23}.

The mobility of the ions in H₂O was examined²⁴ by determining the conductivities of hydrogen and potassium chlorides in ordinary water and in nearly pure H²O. A special pipette cell containing 0.25 c.c. of liquid, with bare platinum wire

electrodes, was used. The amount of H_2O in the electrolytic liquid was determined from the density, and the resistances were extrapolated from 97 per cent H_2O to 100 per cent. The ratios of the equivalent conductances in ordinary water and H_2O were thus obtained. Results at five temperatures from 5° to 18° were found. It is assumed that the ratio of equivalent conductance to equivalent conductance at infinite dilution is the same for each electrolyte in the two solvents and that the ratio of the mobilities of the K^+ and Cl^- ions is the same in both solvents. The mobilities at 18° for H^{2+} , K^+ and Cl^- in pure H_2O are then calculated as 213.7, 54.5 and 55.3, if the corresponding mobilities of H^{1+} , K^+ and Cl^- are 315.2, 64.2 and 65.2. It thus appears that the ionic mobilities in heavy water are distinctly smaller than in ordinary water. The values of the conductance ratios are believed to be accurate to half per cent.

Lewis, even before he had succeeded in concentrating H^2 , had predicted that $\text{H}^2\text{H}^2\text{O}$ would not support life and would be lethal to higher organisms. He then found experimentally²⁵ that minute seeds of tobacco (*Nicotina tabacum* var. *purpurea*) responded to this test. Twelve seeds were placed in pairs in six similar glass tubes and to each of three tubes 0.02 c.c. of ordinary distilled water and to each of the other three tubes 0.02 c.c. of pure H_2O were added. The six tubes were hermetically sealed and placed in a thermostat at 25° . The three pairs of seeds in ordinary water began to sprout in two days, and at the end of a fortnight had formed well developed seedlings. The seeds in H_2O showed macroscopically no development: they have been put in ordinary water but the result is not yet reported. Six entirely similar tubes, each containing two seeds, were filled alternately with ordinary distilled water and with water in which half the hydrogen was H^2 . At the end of four days, all six seeds in ordinary water gave well-developed seedlings, whilst those in the heavier water all showed about the same degree of sprouting as occurs in ordinary water in two days.

The toxic effect of ordinary distilled water is familiar²⁶. A peculiar effect of thermal treatment of water on its capacity for promoting the development of cells of *Spirogyra*, reported by Lloyd and Barnes²⁶, was attributed to the different proportions of polymerised water molecules in freshly condensed steam and freshly melted ice. Ice²⁷ has been regarded as $(\text{H}_2\text{O})_n$, perhaps $(\text{H}_2\text{O})_3$, liquid water as largely $(\text{H}_2\text{O})_2$ with some $(\text{H}_2\text{O})_3$ and H_2O , and dry steam as H_2O . At 20° , it has been calculated, there is 31.1 per cent of liquid ice in liquid water, and freshly melted ice should contain much more $(\text{H}_2\text{O})_3$ than freshly condensed steam, since the changes of polymerisation are not rapid. In freshly melted ice, rich in trihydrol, the cells of *Spirogyra* developed normally, whilst freshly condensed steam, rich in dihydrol and monohydrol, killed the cells. Barnes and Jahn²⁸ have since reported that *Euglena* develops much

more rapidly in water from freshly melted ice than in condensed steam.

Evidence regarding the effect of thermal treatment on the physical properties of water is, however, conflicting. Wills and Boeker²⁹ say that the diamagnetic susceptibility is altered by such treatment, whilst Menzies³⁰ found no alteration of vapour pressure, and La Mer and Miller³¹ no change of refractive index, by such treatment. The latest speculations on the constitution of liquid water³² postulate a tetrahedral co-ordination of water molecules (five H_2O molecules in a group) in ice and two other forms in addition in liquid water.

Until 1894, chemists had no suspicion that the atmosphere contained any constituents other than those recognised by Lavoisier a century previously, and it has required the lapse of a century and a half to establish the existence in water, which like air is one of the commonest materials available to chemists, of anything more than two supposed 'elements', hydrogen and oxygen, each of which is now known to consist of a mixture of at least two different kinds of atoms. The chemical properties of the heavy hydrogen isotope are very probably different from those of ordinary hydrogen. A new organic chemistry, in which each of the compounds containing carbon (of which there are also at least two isotopes, C^{12} and C^{13}) and hydrogen is duplicated by the synthesis of a 'heavy' partner—at present a mere nightmare—will in lapse of time no doubt become an accomplished fact. The use of heavy waters in medical treatment still awaits investigation.

¹ *Phys. Rev.*, **38**, 330; 1930; compare Naudé, *Z. Phys.*, **68**, 362; 1931.

² *Phys. Rev.*, **37**, 1669; 1931.

³ Bleakney, *Phys. Rev.*, **41**, 32; 1932.

⁴ *Phys. Rev.*, **40**, 1; 1932.

⁵ Ballardow and White, *Phys. Rev.*, **43**, 941; 1933.

⁶ *Phys. Rev.*, **41**, 115; 1932.

⁷ *Naturwissenschaften*, **20**, 206, 472, 1932; possible H^3 . Compare also Conrad, *Z. Phys.*, **75**, 504, 1932, neutral H^3 particles in canal rays; Lewis and Spedding, *Phys. Rev.*, **43**, 964, 1933, find no spectroscopic evidence of H^3 , to 1 part in 10^6 , in very nearly pure H_2^2 ; relative fine structures of H^1 and H^2 are given.

⁸ *J. Amer. Chem. Soc.*, **54**, 2562; 1932.

⁹ Harkins, *J. Amer. Chem. Soc.*, **54**, 1254; 1932.

¹⁰ Sexl, *NATURE*, **132**, 174; 1933.

¹¹ *Proc. Nat. Acad. Sci.*, **13**, 496; 1932.

¹² G. N. Lewis and Spedding, *Phys. Rev.*, **43**, 964; 1933.

¹³ Washburn, Smith and Fransden, *J. Chem. Phys.*, **1**, 288; 1933; G. N. Lewis and Macdonald, *ibid.*, 341.

¹⁴ *J. Amer. Chem. Soc.*, **55**, 2167; 1933.

¹⁵ G. N. Lewis and Cornish, *J. Amer. Chem. Soc.*, **55**, 2616; 1933.

¹⁶ G. N. Lewis, *ibid.*, **55**, 3502; 1933.

¹⁷ *J. Chem. Phys.*, **1**, 341; 1933.

¹⁸ *J. Amer. Chem. Soc.*, **55**, 3502; 1933.

¹⁹ Pincass, "Die industrielle Herstellung von Wasserstoff", 53; 1933.

²⁰ *Phys. Rev.*, **43**, 497; 1933.

²¹ *J. Amer. Chem. Soc.*, **55**, 3057; 1933. *NATURE*, **132**, 248; 1933.

²² Lewis and Ashley, *Phys. Rev.*, **43**, 837; 1933. Ashley, *ibid.*, 770.

²³ Chamberlain and Cutter, *Phys. Rev.*, **43**, 772; 1933.

²⁴ Lewis and Doody, *J. Amer. Chem. Soc.*, **55**, 3504; 1933.

²⁵ *J. Amer. Chem. Soc.*, **55**, 3503; 1933.

²⁶ Lloyd and Barnes, *Proc. Nat. Acad. Sci.*, **18**, 426; 1932. *NATURE*, **123**, 691; 1932.

²⁷ Barnes, *Proc. Roy. Soc.*, A, **123**, 670; 1929.

²⁸ *Proc. Nat. Acad. Sci.*, **19**, 638; 1933.

²⁹ *Phys. Rev.*, **42**, 687; 1932.

³⁰ *Proc. Nat. Acad. Sci.*, **18**, 567; 1932.

³¹ *Phys. Rev.*, **43**, 207; 1933.

³² Fowler and Bernal, *J. Chem. Phys.*, August 1933. *T. Faraday Soc.*, **29**, 1049; 1933.

Obituary

DR. H. BOS

THE death of Dr. Hemmo Bos, Wageningen, is a heavy blow to those interested in phenology, which his three years as founder and editor of the international journal, *Acta Phænologica*, had brought yet closer together. On the day, July 29 last, when the appeal regarding this journal appeared in NATURE, he had a seizure which proved fatal and he died on August 18.

Dr. Bos studied botany and zoology at the University of Groningen, his birthplace in 1857. Appointed to teach these subjects at the Wageningen secondary school in 1877, he lived there until his death. During his later years he was director for seed control in the State Experimental Station, doing much valuable pioneer work. With his brother Ritsema in 1881 he published a textbook on zoology for secondary schools, still in use, revised to date. His doctorate thesis in 1885 on the morphology of ants was followed by other publications, especially for horticultural schools, and articles on phenology.

With another brother, P. R. Bos, Dr. Bos initiated in 1894 the Dutch phenological network, and on the death of P. R. Bos in 1901, he undertook single-handed the labour of compilation. In 1921 he organised, and was the soul of, the Dutch Phenological Society. Already he had extensive correspondence with foreign workers. Hence on the appeal in NATURE in 1926, by the Phenological Committee of the Royal Meteorological Society, for greater international co-operation, he recognised

the opening for his projected journal and threw himself heart and soul into its realisation. The three annual volumes so far published form worthy memorials to him. Fortunately his society, under the leadership of his colleague, Dr. M. Pinkhof, to whom I am indebted for the foregoing details of his life, is well qualified to carry on the work, particulars of which appear in the above-mentioned appeal, if only the necessary additional number of subscribers can be obtained.

J. EDMUND CLARK.

WE regret to announce the following deaths:

Prof. F. Fülleborn, director of the Tropical Institute at Hamburg, a pioneer in helminthology and also well known for his anthropological studies, on September 9, aged sixty-six years.

Prof. J. E. Marr, F.R.S., fellow of St. John's College, and sometime Woodwardian professor of geology in the University of Cambridge, on October 1, aged seventy-six years.

Prof. Frederick Starr, professor of anthropology in the University of Chicago from 1895 until 1923, an authority on the ethnography of South Mexico, Central Africa, Japan and Korea, on August 14, aged seventy-four years.

Mr. G. M. Thomson, founder of the Dunedin Technical College and the Portobello Marine Biological Station, president of the New Zealand Institute in 1907-8, an authority on the natural history of New Zealand, aged eighty-four years.

News and Views

Science and Intellectual Freedom

PROF. EINSTEIN'S address at the Royal Albert Hall on October 3 was an eloquent plea for intellectual liberty. The meeting was organised by the Refugee Assistance Committee, and was under the auspices of the Society of Friends, the International Students Service, the Academic Assistance Council, and the Refugee Professionals Committee. Lord Rutherford was in the chair, and on the platform were many leading representatives of science and other branches of progressive thought and action. He said that the object of the four bodies mentioned, and of the organisers of the meeting, was to raise funds for the relief of refugee students, teachers and members of the professional classes of any country which had debarred them from carrying on their work for science and learning through no fault of their own. "Our contribution in this emergency," he added, "must mainly be a financial one, combined with the provision of a temporary refuge in our universities and other learned institutions for some of the distinguished scholars and scientists who find themselves faced with destitution and complete collapse of their academic careers." Prof. Einstein, who was given an

enthusiastic reception by the assembly, congratulated the British people for remaining faithful to the traditions of tolerance and justice which for centuries they had upheld with pride. He pleaded for support from statesmen and the community in the solution of the problem of securing and maintaining peace, and also in the work of education and enlightenment. "If," he continued, "we want to resist the powers which threaten to suppress intellectual and individual freedom, we must keep clearly before us what is at stake, and what we owe to that freedom which our ancestors have won for us after hard struggles."

Human Sterilisation in Switzerland

ON September 27, under the auspices of the International Federation of Eugenics Organisations, a most instructive address on sterilisation as practised in Switzerland was delivered at the Royal College of Surgeons by Dr. Hans Maier, director of the Psychiatric clinic attached to the University of Zurich. It appears that sterilisation, which Dr. Maier carefully distinguishes from castration, has been practised in Zurich for fifty years. In Switzerland, each canton

makes its own laws, and what Dr. Maier had to say applies primarily to the canton of Zurich. The enlightened laws of this canton forbid the marriage of the insane and mentally deficient and ordain that if such marriages are contracted in defiance of the law, they shall be dissolved. Sterilisation (that is, ligation of the genital ducts) is legal in Zurich if it is performed on medical grounds; but the judges have ruled that if the condition of the affected person is such that it is certain that he or she will produce defective offspring, then that is a sufficient medical ground for sterilisation. The insane, which in practice means persons afflicted with recurring attacks of insanity, and the obvious mental defectives, are confined in asylums; but this involves a very heavy expense to the canton, and the effort is made by nursing and rest to restore them to a better state of health and then to give them their freedom. If they are sterilised before they go out, all fear of undesirable progeny is eliminated. Sterilisation is also performed where a woman in poor circumstances, who has had a large family and is unable without grave risk to bear any more, desires it, but the written consent of the patient is required. A curious point arises in connexion with what are called borderline cases of mental defect, that is, high grade mental defectives. If, Dr. Maier states, the mental defect is accompanied by moral defect, then sterilisation is insisted on, for experience has shown that such moral defect is very prone to be inherited.

The Eugenic Problem in Great Britain

Scientific men generally, we think, will view with approval the sterilisation laws of Zurich; if obvious mental defectives were sterilised in England, it would be a great benefit, and it would in some degree diminish the numbers of the 'social problem group', but it would not solve the great eugenic problem which confronts the country. Mental defect is not a clearly defined factor or 'gene' but a damage of infinitely graded character. In its higher grades it merges insensibly into mere foolishness and idleness. Yet it is precisely these grades which produce most offspring and hand on the defect to posterity. Until the second half of the nineteenth century, these unfortunate offspring to a large extent died out before producing children. But our social legislation has raised their survival rate and thrown the cost of their maintenance on the really fit members of the community, who have in consequence restricted the numbers of their own offspring. These high grade defectives are people whom no government would dare to sterilise as a result of an examination in a mental clinic, and Dr. Maier frankly admits that this is so. A remedy for this state of affairs would be to adopt sterilisation as a penalty for bringing into the world children whom the parents are unable to support. It would be to apply compulsorily the treatment which Dr. Maier gives to poorer class women of Zurich with their consent. Public opinion in England will not easily be reconciled to this course, but if our over-population and unemployment continue, we may ultimately be driven to it.

Sale of Iron Age Antiquities

WHAT is undoubtedly the most important collection of prehistoric antiquities ever to come under the hammer is to be offered for sale at the American Art Galleries, New York, in the late autumn. The collection of some 20,000 bronze and iron objects, known as the "treasures of Carniola", is to be sold by order of the Duchess Marie Antoinette of Mecklenburg. It is her private property and was formed as the result of ten years' excavation in Carniola, about 200 miles south-east of Hallstadt, where some 1,300 tombs were opened; but it also includes material from a number of smaller sites outside Carniola. The excavations were made under an exclusive licence granted to the Duchess. As the antiquities were obtained at the very heart of the region in which the Hallstadt Iron Age civilisation developed, its importance for the archaeologist is manifest. Yet until now, little has been known of it. The finds range in time from the finest period of the Hallstadt culture down to the beginning of the Roman Provincial civilisation and thus cover a most important period in the development of European peoples. Although all the objects in the collection have been photographed by the authorities of the Swiss Federal Museum in Zurich before shipment to the United States, it will be little short of a calamity that such a collection should be dispersed. Its unique interest and scientific value lie in the fact that as a whole it represents with a measure of completeness the development of culture in one area over a considerable period of time, thus illustrating important phases of transition in European prehistory. Even in the unlikely event that the collection should be purchased as a whole, its divorce from its country of origin, or at least from Europe, is to be deplored. The fate of the collection illustrates once more the danger of private ownership of antiquities which are primarily national possessions but none the less of vital interest to the whole world of archaeological science.

Cost of German Scientific Periodicals

THE complaints with regard to the high cost of German scientific periodicals, which were detailed in an article by Dr. Wilfrid Bonser, librarian of the University of Birmingham, in *NATURE* of July 1, p. 34, were embodied in a memorandum which was sent to the Börsenverein der deutschen Buchhändler on June 1. This memorandum was signed by the vice-chancellors and principals of all the universities and university colleges of Great Britain, and by the presidents of most of the scientific societies interested. An answer has now been received from the Börsenverein. This announces that an agreement has been made between the Börsenverein as representing the publishers and the Verband der deutschen Hochschulen as representing the contributors to the journals. The various demands that have been made in Germany, Great Britain and the United States are dealt with and acceded to. The maximum size and price are in future to be announced beforehand and adhered to, thus enabling librarians to budget

in advance: the greatest concentration and discrimination will be exercised by the contributors: dissertations will be rejected as having no proper place in periodicals. It is expected in consequence "that periodicals inflated in size and price, especially in the field of medicine and natural sciences, will be cut down from 1934 onwards by at least 20% in size and price as compared with the position in 1933". The Börsenverein declares that it will regard non-observance of this agreement as "an offence against the statutory duties of its members".

Thomas Young and Colour Mixtures

FOR the Thomas Young Oration delivered before the Physical Society on October 6, Dr. Herbert Ives chose for his subject "Thomas Young and the Simplification of the Artist's Palette". The experimentally well established fact enunciated by Thomas Young that all colours may be matched by the mixture of three properly selected primaries, has been extensively used in colour photography and typographic printing. It has not, however, been heretofore successfully used in painting. The simplification indicated by the three-colour principle has been retarded in realisation largely owing to the mistaken, but widely held, belief that the primary pigment colours are red, yellow and blue. Actually the pigment primaries, which act by subtraction or absorption of light from white, should be complementary in hue to the red, green and blue, which are the primaries for mixing light by addition. Those colours are minus red (spectrum minus red) or turquoise, a minus green or crimson, a minus blue or yellow, each having wide overlapping spectral reflection bands. Pigments of these colours, of proper spectral characteristics, are capable of mixing in pairs to make red, green and blue, and all three together to make black. When mixed with white all variations of saturation and hue are obtained. The practical problem consists in procuring pigments possessing the indicated spectral reflectivities, and having satisfactory chemical properties, such as freedom from reaction with the oil or other medium, and satisfactory permanence. Due to the very great advances which have been made in the dye industry to meet recent demands for permanent colours for automobiles and outdoor signs, it is now possible to select pigments nearly enough meeting the scientific requirements to test the practicability of the principle. This has been done with success, and pictures so painted were exhibited in connexion at the meeting. The great advantage of a three-colour palette is its simplicity and freedom from ambiguity.

Diet and Cancer

MANY food products of the most varied kinds have been incriminated from time to time as being causative of the supposed increase of cancer. One of these in particular is the tomato, and Bellows and Askanazy of Geneva have stated that they have produced in white rats cancer of the sarcoma type by injection of tomato juice or of a particular bacillus obtained from the tomato, and also by feeding the

animals with the juice. In a recent communication in the *Lancet* (Sept. 23, p. 698) M. J. A. des Ligneris records attempts to confirm these observations in South Africa, with completely negative results. Others have also similarly failed, and it is mentioned that Askanazy himself in another series of experiments obtained no further positive results. It is suggested that the presence or absence of some constitutional factor in the experimental animals determines whether or no cancer develops. If this factor is present, any adequate chronic irritation, such as that produced by tomato juice, suffices to induce cancer formation.

The Bureau of Mines and the U.S. Petroleum Industry

MR. H. C. FOWLER in his paper on "Petroleum and Natural Gas Studies of the United States Bureau of Mines" (Information Circular 6737, July 1933) gives an important résumé of the work of the petroleum and natural gas division of the U.S. Bureau of Mines. The chief motive of the Bureau is to collect and correlate the best available knowledge and information regarding physical phenomena, and thereafter make analyses of the data received with the view of delineating laws and fundamental relationships having practical application to problems of economic production, transportation and manufacture of gas and oil. During recent years, with the rapid growth of the industry, innumerable complex problems have arisen and in consequence the scope of the Bureau's work has changed and enlarged materially since its inception in 1914. The technique of practical oil and gas production is now more generally known and the Bureau is, therefore, able to concentrate on studies of a fundamental nature and on problems incapable of solution by individual concerns. Technical problems now confronting the Bureau concern refining; production of gas and oil, including related problems of pipe-line transportation of natural gas; engineering field studies; and special engineering problems, including technical research for information sought by the industry. The chief value of the Bureau's work, however, lies not in the multiplicity of problems under investigation but in the fact that all published information is definitely based on results of commercially independent experimentation and investigation. No statistics or data are published without being first subjected to rigorous scrutiny within the Bureau, and frequently such information is critically reviewed by recognised national authorities in the industry before release. Finally, the Bureau places its detailed and valuable findings without reservation at the disposal of a world-wide technical public, long since mindful of its obligation to a most efficient and learned body.

Suspension of Excavation at Verulamium

AT the close of the present season, the excavations on the prehistoric and Roman sites of Verulamium at St. Albans, it is announced, will be suspended for a period of indefinite duration. The Excavations Committee, under the supervision of which the work

has proceeded, will remain in being, and the finds are to be handed over to the Corporation of St. Albans. The present investigations at St. Albans have occupied three years. The results, as was anticipated from the importance of Verulamium in the polity of early Britain, have been as fruitful as any ever obtained from a Romano-British site, and, in fact, have exceeded expectation. They fully justify the necessarily heavy expenditure; and a correspondingly heavy burden of gratitude is laid on the learned world to Dr. and Mrs. Wheeler and their assistants, as well as to the Excavations Committee and the Corporation of St. Albans, through whom they were made possible. While there can be no doubt that the means will be forthcoming for continuing the investigation in due season, an intermission, provided it be not too long, is by no means entirely a misfortune. These three years of excavation have produced a mass of material which demands a breathing space for its proper digestion.

Romano-British Pottery

A KNOWLEDGE of the names of the potters by whom the pottery found on Romano-British or British sites was made is obviously of great value to the archaeologist in the interpretation of the ceramic evidence. If the site of the potter's factory is known, as it is in many instances, it serves to indicate the trend of cultural and commercial relations. Among the firstfruits of this season's excavations at Colchester has been the identification of names of two potters inscribed on the 'Samian' (Terra Sigillata) ware. Examples of these makers' ware had previously been found at both Colchester and Verulamium. There are, however, indications that evidence may be forthcoming pointing to a local factory, thus confirming the view that Samian ware was manufactured in Britain as well as imported. In the study of Samian ware, Dr. Felix Oswald's "Stamps on Terra Sigillata" (privately printed, 1931) is indispensable; but although every effort was made to make that list complete, additions, whether from excavation or from examples in museums, are bound to come to light from time to time. A considerable number of examples not recorded in Dr. Oswald's lists, though all by previously known potters, will be found in a "Catalogue of Potters' Stamps on Terra Sigillata found in Gloucester", by Mr. Charles Green, curator of the Gloucester Museum (Public Museum, Gloucester, Occasional Papers No. 1. Price 6d.), which has recently been issued by the Museum authorities. There are in all fifty-six specimens, ranging in date from Nero to Antonine. The pre-Flavian and Flavian stamps are all of South Gaulish potters. Thirty-nine come from central Gaul and three from eastern Gaul.

Archæological Exploration on Monte Alban, Mexico

A DISPATCH from Mexico City addressed to Science Service, Washington, announces that Señor Alfonso Caso, who is in charge of the exploration of the ruins on Monte Alban, Oaxaca, proposes in the coming season to open up the great "South Terrace" of the

acropolis, which is regarded as in all probability the most important part of the site. It has been left unexplored up to the present in order that the work may be carried out in the light of experience on the site. The acropolis is a tableland on top of the mountain, approximately a third of a mile long. The "North Platform" was explored last year. The "South Terrace", judging by the contours under the earth covering it, should be richer in remains than any part explored up to the present. Mounds superimposed upon mounds make this the highest point on Monte Alban. At the south-east corner is a mound with a hollow rotunda, which the late Mrs. Zelia Nuttall held to be an astronomical observatory, and considered the most important monument in Mexico in view of its relation to the calendar cultures of America.

South African Wild Flowers

AN exhibition of South African wild flowers is to be arranged under the auspices of the Royal Horticultural Society on October 24 and 25. This exhibition, which is to be opened by H.R.H. Princess Alice, Countess of Athlone, has been organised by an influential committee in South Africa and with the official patronage and co-operation of the High Commissioner for the Union of South Africa in London. A remarkable range of wild flowers, aloes and succulents, collected from twenty different districts in South Africa, has been dispatched, and the exhibition will provide the most representative and complete display of flora ever sent overseas from this Dominion. It will include many species of great beauty and rarity. Notable among the displays will be the remarkable variety of heaths, such as mealie heath (*Erica abietina*); dark-mouthed heath (*E. saccoiflora*); red and yellow heath (*E. exurgens*); Walker's heath (*E. Walkeria*); pink drooping bell heath (*E. propendens*); riversdale orange-and-green heath (*E. blenna*); many varieties of everlastings; grasses; orchids; numerous varieties of proteas, such as woolly-bearded protea (*Protea barygera*); giant or king protea (*P. cynaroides*); and the pin-cushion protea (*P. leucosperum*); specimens of bulbous plants, gladioli, succulents and aloes. The greatest care in handling and in the regulation of temperatures has been necessary in picking, packing and conveying these floral treasures from South Africa for their long journey of 6,000 miles to London. This in itself will make the exhibition noteworthy. The exhibition will be staged in the Royal Horticultural Society's Hall in Vincent Square, S.W.1, at the same time as the Society's Orchid Show in the new Hall; tickets of admission to either display will permit of entry to both halls.

Electrical Accidents in 1932

THE report on electrical accidents in Great Britain for 1932 (London: H.M. Stationery Office, 4d.) is both interesting and full of useful information. The total number of electrical fatalities due to electricity last year was 70, of which 14 occurred in premises of a domestic character. It is stated that there are fewer

accidents in Great Britain than elsewhere. The electrical industry is one of the few major industries which has remained active during the past few years. Employment on the supply side increased by 50 per cent between 1924 and 1930. Notwithstanding this increase in the number of employees the number of fatalities remains practically the same. It is well for employers and occupiers to remember the law as recently laid down in High Court decisions that it is their duty to protect the workmen against their own errors, and it may be their own folly. It is not sufficient merely to give a warning. Although trade depression has been acute, the re-equipment of textile mills has been steadily progressing and the applications of electricity in factories is still increasing. Foreign firms have started branches in Great Britain which are fully equipped electrically. Luminous tubes are coming rapidly into use and although their manufacture involves high pressure, there is almost a complete absence of accidents. Several accidents from severe shock have been reported where the prompt use of artificial respiration probably saved the injured persons' lives.

History and Development of Electric Power

THE history and development of electric power has recently been reviewed in a handbook by W. T. O'Dea (South Kensington, Science Museum Handbooks. "Electric Power", Part I, "History and Development". London: H.M. Stationery Office, 1933. 2s. net). This handbook should prove of the greatest value to inventors of electrical devices. An excellent historical account is given of the development of the various sections of the electrical industry. Notable apparatus illustrating the various stages in the development of the art and represented in the Museum by originals or replicas are indicated by asterisks. Anyone therefore who has read this book beforehand will be able to derive the full benefit from a visit to the Museum. Clearly printed photographs are shown illustrating the latest devices and methods used in engineering; they include a mercury arc rectifier, high-tension lattice towers, methods of transporting heavy engineering apparatus, etc. Many of the objects exhibited at the Faraday centenary exhibition are now included.

Fishes of the Thames Estuary

IN the *Southend Standard* of August 24, Mr. A. Laurence Wells writes a very interesting article based on further notes from Dr. Murie's work on the Leigh fisheries. This includes a list of all fishes recorded from the Thames estuary with remarks on each species. Considerable changes have occurred in the fish fauna during the last few centuries. Long ago salmon were abundant, coming up the river to breed; after 1833 none were seen, the pollution of the river cutting them off from their favourite haunts. Now they are returning since the conditions have been much improved. The salmon trout was far commoner in Elizabethan days than at the present time although a few may still be taken. The smelt fishery used to be much more important than it is now. The Thames

sturgeon was celebrated in former years and is still fairly common in the estuary. Some fishes come for breeding purposes, others occur only as fry, many are permanent inhabitants or regular seasonal visitors. The herring in late summer forms 80 per cent of the whitebait; there are no less than fifteen species of the flat-fish family, eleven of the cod family and six of the herring family, whilst almost every group of fishes is represented. Rarities include specimens of the sword-fish, the pilot-fish and the flying-fish.

Medical Census of Nigeria

WE have received two volumes of the medical census of Nigeria, vol. 5, Northern Provinces by Dr. R. C. Jones, and vol. 6, Southern Provinces by Dr. J. G. S. Turner ("Census of Nigeria, 1931". Crown Agents for the Colonies, 1932. 4 Millbank, London, S.W.1. Price 7s. and 8s. respectively). Attention is directed to the difficulties of obtaining reliable data in a native population, so that the results are approximate only. Details are given of the climate, sanitation, and social customs of the districts. The percentage of males and females at all ages are approximately the same. Children are welcome, and the birth-rate is high, 40-55 per 1,000. As might be expected, the infant mortality rate is high, as much as 250-350 per 1,000 births. Smallpox is prevalent, and in some districts more than half the population have suffered attack. The percentage vaccinated varies much, from scarcely any in some areas to 90 in other areas. Malaria is hyperendemic and there is some leprosy. A note on the covers of the volumes of the census states that an insecticide has been used in the binding so as to render them impervious to the ravages of insects.

Recent Earthquakes in China

BETWEEN August 23 and 31, a series of destructive earthquakes occurred in the northern part of the province of Szechuan. In the valley of the Min, a tributary of the Yangtze, great damage was caused in the portion between Sungtan and Mowchow. According to a message in the *Times* for September 20, the earthquake was accompanied by a sudden upheaval of the bed of the Min, by which its waters were made to flow upstream. One member of the series was probably that recorded at West Bromwich on August 25, the greatest registered there during the last six months. In past times, and especially just before and after the beginning of the Christian era, the province was frequently visited by destructive earthquakes that gave rise to many landslips among the mountains. On two occasions, in 26 and 10 B.C., these landslips obstructed the flow of the River Min.

Empire Marketing Board's Film Library and Cinema

A SIDE-LINE of the activities of the Empire Marketing Board, which came to an end on September 30, was the collection of a valuable library of instructional films and the maintenance of a cinema at the Imperial Institute. A few days ago it was announced that the

Postmaster-General had taken over the film library, thereby saving it from dispersal. Now we learn that, through the generosity of a private individual in Scotland, it will be possible to continue the displays of Empire films in the cinema attached to the Imperial Institute Galleries. A full programme of films, lectures and talks on the British Empire has, therefore, been arranged for October and particulars of this may be obtained free on application to the Secretary, Imperial Institute, London, S.W.7.

Magnetic Chart of the Ukraine

WE learn from the Society for Cultural Relations (S.C.R.) that the expedition from the Odessa Geophysical Observatory, under the leadership of Prof. M. A. Aganin, has completed the survey work in the Ukraine, and a magnetic chart of the whole of the Ukrainian Soviet Republic will soon be available. The survey has established the fact that the so-called Kursk magnetic anomaly extends over territory far beyond Kursk, reaching Kharkov.

Exploration of the Stratosphere

THE Russian experimenters at Moscow succeeded in launching their stratosphere balloon *Stratostat U.S.S.R.* on September 30, and ascended to a height of some 19,000 metres. The balloon landed safely at Kolonna, about seventy miles south-east of Moscow, after a flight of seven hours. The sealed gondola, made of duralumin, was manned by MM. Prokofieff, Birnbaum and Godunoff, the latter of whom made scientific observations. They were in touch with the Popoff wireless station in Moscow during the flight. A preliminary report from the Riga correspondent of the *Times* states that the minimum external temperature recorded was -67°C .

Announcements

THE Chemical Society has arranged a lecture, with experiments, by Prof. W. A. Bone on "The Combustion of Hydrocarbons", to be delivered at 8 p.m. on October 19 at the Royal Institution. Admission is free, without ticket.

PROF. E. A. MILNE will deliver an address entitled "Some Points in the Philosophy of Physics: Time, Evolution and Creation", at University College, Gower Street, W.C.1, at 8.15 p.m., on Tuesday, October 17, under the auspices of the British Institute of Philosophy. Prof. E. N. da C. Andrade will be in the chair. Tickets can be obtained from the Director of Studies, at University Hall, 14 Gordon Square, W.C.1.

ON September 28, M. Lemoine established a new altitude record for an aeroplane in a flight at Villacoublay. It is stated in the *Times* that the official figure for the height reached is 13,661 metres.

FIFTY years ago, the late Sir Alexander Kennedy founded the Engineering Society of University College, London. The jubilee will be celebrated by a dinner to be held on November 16 at the College.

Old students of the Faculty of Engineering of the College proposing to be present should communicate with Prof. W. C. Clinton, University College, London, W.C.1.

LORD IRWIN, president of the Board of Education, will make a presentation, on behalf of the Advisory Council of the Science Museum, on October 11 at 10.30 a.m., to Sir Henry Lyons, the retiring director of the Museum. An appreciative note, referring to Sir Henry's twenty-one years of service in the Science Museum, appeared in our issue of July 8, p. 55.

DR. Å. VEDEL TÅNING informs us that the collections of the *Dana* expedition, and also those of the Danish Commission for the Exploration of the Sea referring to the Faeroe Isles and Iceland, hitherto housed in the late Prof. Johs. Schmidt's department at the Carlsberg Laboratory, have been transferred to the Marinbiologisk Laboratorium, Vestre Boulevard 42, Copenhagen, v.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—Six inspectors of factories (Class II)—Industrial Division, Home Office, London, S.W.1 (Oct. 9). A temporary mechanical engineering draughtsman, Air Ministry, and a temporary assistant in the Designs Branch of the Directorate of Works and Buildings, Air Ministry—Secretary (S. 2), Air Ministry, Adastral House, Kingsway, W.C.2 (Oct. 10). A principal of Londonderry Municipal Technical School—Secretary and Executive Officer, Education Office, Guildhall, Londonderry (Oct. 13). Assistant civil engineers, Air Ministry—Secretary (S. 2), Air Ministry, Adastral House, Kingsway, W.C.2 (Oct. 14). A lecturer in the department of mechanical and civil engineering, Sunderland Technical College—Chief Education Officer, Education Offices, 15 John Street (Oct. 16). A lecturer in horticulture in the Department of Agriculture of the University of Leeds—Registrar (Oct. 23). A visiting teacher for refrigeration engineering at the School of Engineering and Navigation, Poplar, E.14—Education Officer (T. 1), County Hall, S.E.1, with stamped addressed foolscap envelope (Oct. 26). Probationary inspectors (male) in the engineering department of the Post Office—Secretary, Civil Service Commission, Burlington Gardens, London, W.1 (Oct. 26). A research fellow for investigations in the University of Leeds in association with the Harrogate Royal Baths Hospital, into the cause and care of chronic rheumatism—Registrar, University, Leeds (Oct. 28). An assistant librarian in the Nottingham County Library—Director of Education, Shire Hall, Nottingham (Oct. 31). A head of the Department of Sanitary Engineering and Plumbing in the Victoria Jubilee Technical Institute, Matunga, Bombay—The *Engineer* Office, 28 Essex Street, W.C.2.

ERRATUM.—Dr. C. J. Gorter writes pointing out that formula (3) in his letter "Remanence in Single Crystals of Iron" (*NATURE*, Sept. 30, p. 517) was incorrectly written in his manuscript as $F_d = 2\pi I_p^2$. It should be $F_d = \pi I_p^2$.

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Reviews

Alfred Mond: A Character Study

Alfred Mond, First Lord Melchett. By Hector Bolitho. Pp. xii+392+17 plates. (London: Martin Secker, Ltd., 1933.) 21s. net.

MANY are risen to greatness from lowliness; far less numerous are they who have gained special distinction when starting high up in the social scale: a father before one, if wealthy, is a bar almost impossible to surmount. This, in large part, is the key to the life of Alfred Mond. Mr. Bolitho's book is a discursive story of his attempt to secure an independent pedestal—his failure to satisfy his ambition. As a study in heredity and of the influence of social surroundings, the story has many elements of interest; unfortunately, it is not told in a manner to make the book of value to the student—too much has to be read between the lines and little if any evidence is produced—nor does it in any sufficient way do justice to its subject.

The author has been at the great disadvantage of never having known the man he would portray. He therefore writes only from hearsay, with knowledge of documentary material from which he has not been at liberty to quote, in a Stracheyesque style that amounts to little more than hero worship; the account not only lacks feeling but also has a false ring of reality and an assumed intimacy which, at times, is very unpleasant. I can imagine what the father, Ludwig Mond, would have said to such florid presentation of the family doings: I fancy his choicest 'Billingsgate', of which he had a wonderful repertory, would have been let loose upon it.

Father and son were very diverse natures, with little if anything in common; nor was the son specially his mother's son. A separate picture of the son would have been far more valuable, if based upon Hansard and his correspondence, so that his actual achievement could have been measured: the superficial laudatory blend put before us is a Galtonian composite in which neither of the originals is ever in proper focus. Instead of a clear-cut portrait, we have the laboured design of a literary decorative artist—spoilt by

over-use of colour. No mere writer can possibly put feeling into the life of a man brought up as was Alfred Mond—in an atmosphere, in which æsthetics prevailed, with a strong industrial-scientific undercurrent but no belief in nor any care for politics. When, in early life, with no inner *Drang*, in search of a career he entered politics, he chose the Liberal party, as a lawyer would, not through conviction but definitely because it offered the greatest chance of a public position. We are told that, in answer to his astonished father's question, when he made his decision known, he replied: "I have chosen them because I have examined all the parties and I find that there are less clever men among the Liberals than any other." He was already a cynic and adopted a pose, as do most politicians; still, he always played an honest hand. The book makes clear that when (having exhausted his Liberal chances he passed over to the Conservative side) he had found his spiritual home but only to meet with further disappointment, he never really changed sides but only repaired the error of his youth—the Liberals were far too conservative and narrow for a man who had sucked the stimulating sponge of a highly developed scientific industrialism in the way he had. As Mr. Lloyd George said of him: "not one of his associates had a tithe of his knowledge". He had not merely knowledge but also an unique experience in the example set by his father and John Brunner—the latter a man as remarkable almost in his way as was his partner. Ludwig Mond was not a money-making manufacturer, though in the end he made millions and lost not a little in making them—he was both an industrial explorer and a pioneer, working in the spirit of a Faraday, an industrial philanthropist. More than once, his wonderful wife has said to me: "*Ludwig will nicht nur Geld machen, er will immer etwas Neues thun.*"

His elation when the great nickel discovery was made—I think by Dr. Quincke—was overwhelming but he was perhaps more pleased to have saved the nitrogen of coal—a feat his son was to render of no account; to-day coal tar ammonia runs to waste and spoils filter beds.

The Jew in Ludwig Mond was entirely merged in the scientific purpose and clear objective behind all his work. The late Sir Charles Parsons seemed to me to have this outlook. I doubt if any other industrialists, in my time, have gone so far or worked with such purity of motive as these two did.

There was no such force behind Alfred Mond: had there been, had he been in any way original, he would have won through. His dreams of the Exchequer, even of Downing Street, proving illusory, he found himself at the edge of a social precipice, unable to satisfy his ambition to dominate. In fact, he had no real objective—no scientific afflatus. His character came out in his early youth, at Cambridge, where he was an addict to poker, a game of pure speculation; higher interests gradually prevailed and he did much useful administrative work but, in the end, he returned to poker and on a disastrous scale. Finally, he was on the point of retiring to Palestine—perhaps seeing there the possibility of exercising patriarchal rule. The call of the blood was upon him and it seems now to have fallen upon his son, who has openly professed the Jewish faith. To geneticists, the story should be one of peculiar interest. Chemists, some day, perhaps may be able to outline the peculiar types of protein structure or of minute drug control which carry us this way or that, into one or the other religious faith, make us fit or unfit for the task undertaken.

Alfred Mond failed politically, for the simple reason that he lacked the necessary social qualities and was too superior, if not imperious. He became a peer by his own request. He had a great opportunity, which he missed: he changed his name—an act not to be forgiven. So great a name as his father's should have been carried into the Lords: the act was proof how little he had learnt to think of others, how slight was his sense of proportion. In fact, he was a self-centred aesthete and was meant to be an anchorite, not a man of action. He was ever wrapped up in himself and regardless of others to an exasperating degree. This is made clear over and over again in the book. Only once did I get within his skin. We were together on the 'nitrogen joy ride' in the Adriatic—a large and varied party on shipboard, during a week. The whole time, he held himself strangely aloof, commanding to his cabin the few with whom he wanted to talk business. I believe that he was really always thinking hard what was the right thing to do in the general interest. At Corfu, we

happened to go ashore together and, finding ourselves alone, he suggested that we should visit the Grecian ruins close at hand. I never enjoyed two hours more—he knew everything and talked on and on of the past, in a most engaging manner, satisfied to have an interested listener. There was no striding about, no interrogatory 'What?' referred to by Mr. Bolitho as characteristic of the family. He lost himself in his subject.

In simple surroundings, Alfred Mond might have done great things: his position made this impossible for him, the more as, consigned to the neglect of Cambridge, he entered upon life without either discipline or rational training and without enthusiasm. On the other hand, he is as striking a proof as can be found, that education and environment count for very little and that we are what we are in virtue of innate tendencies: his gifts were administrative and commercial and in these spheres he was eminently systematic and thorough in his outlook. The spirit of natural science, its ecstasy, in no way entered into his soul, notwithstanding the example before him in his father and the fact that his elder brother's interests lay in this field. We have to go further than the chromosome to understand these differences: we should allow for them more than we do in education and in affairs.

Mr. Bolitho's book is unsatisfactory because it tells us nothing. Alfred Mond was a man of unusual intelligence and did good work in many ways: we may hope that someone who knew him will be found, without delay, to give a considered and critical account of his doings. A general laudatory notice of such a man is not only an injustice to his memory but also deprives society of valuable information. He was an advance on the normal professed politician—in what way was he an example for an improvement of the species?

H. E. A.

Technique of Mathematical Analysis

The Theory of Functions. By Prof. E. C. Titchmarsh. Pp. x+454. (Oxford: Clarendon Press; London: Oxford University Press, 1933.) 25s. net.

THE middle-aged mathematician is painfully aware that a knowledge of the treatises on analysis from which he was learning twenty or thirty years ago does not enable him to read today's researches, and he wonders what is the equipment that has taken the place of the facilities

his contemporaries laboured to acquire. The eager student, having mastered Hardy's "Pure Mathematics", asks "What next?" To both inquirers, Prof. Titchmarsh's book, based on lectures delivered in London and Liverpool, presents an answer in the form of "some rather disconnected introductions to various branches of the theory of functions, both real and complex".

The scope of the book cannot be indicated briefly. Chap. i is on infinite series, products, and integrals, and includes most of the standard processes of inverting a double-limit operation. Chap. ii, on analytic functions, includes a proof that an integral involving a parameter is in certain circumstances an analytic function of that parameter. Chap. iii, on contour integration, is perhaps characteristic: there is so little practice with residues that Jordan's lemma does not find a place even among the examples, but there are two proofs of Poisson's formula and two of Jensen's. In Chap. iv, on continuation, prominence is given to the persistence of functional equations, with examples from the gamma and zeta functions, and to the occurrence of natural boundaries; on the other hand, the few sentences on algebraic functions and Riemann surfaces do not amount even to an introduction, so that again one is inclined to ask if collateral use of some old-fashioned treatise is not tacitly implied in the selection of material. Chap. v, on the maximum modulus principle, is excellent; to emphasise the importance of the fundamental theorem, in spite of its simplicity, three distinct proofs are given, and the number of applications is considerable; the ground is, of course, well known to mathematicians—it is covered, for example, in a long section of Pólya and Szegő's "Aufgaben"—but an exposition in an English textbook was long overdue.

There is a great gulf between the two parts of Chap. vi, on conformal representation. The first half, in which a few simple transformations are analysed in detail, is out of place and superfluous: the elementary treatment of the subject belongs to an earlier stage of mathematical development, the work is done more completely by Hardy, and the only excuse for a discussion here would have been some such maturity of outlook as distinguishes even the opening sections of Carathéodory's tract. The second half of the chapter introduces simple (that is, biuniform or *schlicht*) functions, gives Schwarz's formula for representation of the inside of a polygon on a half-plane, and uses the

maximum modulus principle to establish Riemann's fundamental theorem on the transformation of an arbitrary region into the unit circle.

The subject of power series falls naturally into two divisions. To series with a finite radius of convergence belong problems of over-convergence and gaps and of asymptotic behaviour, the theorems of Abel and Tauber, with the converse investigations and extensions due to Hardy and to Littlewood, and the properties of partial sums, culminating in Jentzsch's remarkable theorem on zeros; these form the substance of Chap. vii. Chap. viii, devoted to integral functions, is concerned with the mass of theorems on zeros and factorisation which lies between Weierstrass's use of primary factors and Picard's discovery of the impossibility of two exceptional values.

Chap. ix deals in an elementary way with the simplest type of Dirichlet series, the series $\sum a_n n^{-s}$, and contains accounts of the several regions of convergence, of the mean value theory, and of the distribution of zeros; certain of the series fundamental in the theory of primes are introduced as examples, but there is no attempt to explain how the theory is advanced by their help.

The last four chapters are concerned with functions of a real variable, three chapters on measure and Lebesgue integration preparing for the final chapter on Fourier series, where needless to say the principal result is given in Fejér's form; after Parseval's theorem and the Riesz-Fischer theorem and two theorems of Riemann's on trigonometrical series, a few pages on integrals and transforms end the book.

The most serious defect of this work is that the author does nothing to enable us to follow up his introductions with a view to closer acquaintanceships. There is a random bibliography of thirty-five books, and against each title are the numbers of the chapters of Prof. Titchmarsh's book which are amplified there, but if he has interested us in the subject of analytic continuation, let us say, a list without comment of ten treatises, from Appell and Goursat's "Fonctions Algébriques" to Whittaker and Watson's "Modern Analysis", is not specially helpful.

The two parts of which the book really consists are not unified by being put between the same covers. This the author admits, explicitly when he says that the last four chapters can be read at any time after the first chapter, and implicitly when in Chap. ix he refers rightly to results in Chap. xiii. Although the range is wide, there is a

disappointing narrowness in ideas. This criticism may be illustrated from the first chapter and from the last. The concept of uniformity of convergence has nothing whatever to do with series as such, and there is something childish, which the mathematical world should have outgrown, in utilising an example like $1/(1 + nx)$ by solemnly constructing the series $\Sigma [1/\{1 + nx\} - 1/\{1 + (n-1)x\}]$. Fejér's theory of Fourier series involves summation by arithmetical means, but far from taking the occasion to introduce the general concept of summability, Prof. Titchmarsh is content to define only the particular sum he requires and to leave the phrase 'means of the first order' and the notation $(C, 1)$ alike unexplained. By the way, speaking of terminology, must we admit *decimals* in the scale of seven, and need we take the risk of confusion involved in describing $(az + b)/(cz + d)$ as a *linear function* of z ?

The middle-aged mathematician to whom reference has already been made will feel that the younger generation is missing a great deal of fun when he finds that there is not a word about doubly periodic functions in the book. He will notice with surprise that the index makes no mention of asymptotic expansions or of the method of steepest descents. Gradually he will realise that the importance of this book is not, as might be expected, in the width of range, but in the precision with which the details are handled. When all complaints have been made, students for whom the book is written are to be congratulated on the opportunity of learning the use of modern analytical technique in an immense variety of applications from such a master of technique as Prof. Titchmarsh, and Prof. Titchmarsh is to be thanked for a volume in which there is not a careless paragraph or a dull page.

E. H. N.

Optical Instruments

An Introduction to Applied Optics. Vol. 2: Theory and Construction of Instruments. By Prof. L. C. Martin. (The Specialists' Series.) Pp. ix + 289. (London: Sir Isaac Pitman and Sons, Ltd., 1932.) 21s. net.

THERE was a time when one man was able to learn the whole of science: for example, we are told that Moses learnt all the wisdom of the Egyptians, and so late as the sixteenth century John Baptista Porta, a Neopolitan youth of eighteen years of age, attempted to set out all

the then known science in his "Magiæ Naturalis", a book which became very famous and was translated into many languages. Even a hundred years ago it was possible for such a man as Thomas Young to master the greater part of human knowledge. But during the last century the growth of knowledge has been so great that it is no longer possible, even in a single field, for any man to keep abreast of the advancing tide of discovery, still less is it possible to have more than a general acquaintance with other branches of science.

Hence it comes about that workers in one branch of science have increasingly to take for granted the results of other branches. This applies not only to the knowledge itself, but also to the applications of that knowledge. Thus users of mechanical, electrical and optical instruments—balance, X-rays, microscope, telescope, spectroscope, and other instruments—are in the habit of using them with little or no knowledge of the principles underlying their design and function. This would be of small importance were it not for the fact that this lack of knowledge may prevent the full value of the instrument being utilised.

This is especially true of the microscope. How many botanists, for example, or how many medical men, even perhaps those engaged in histological research, appreciate the importance of a good condenser, correctly centred and focused, if they are to obtain the best definition that a given objective is capable of affording? Or again, how many know the limits of fineness of structure that they should be able to observe with that objective? Yet these are matters of serious importance to the research worker, and for such a worker the second volume of Dr. Martin's "Applied Optics" should prove of real value, for in it the author has set out in a clear and readable manner the underlying principles of the functioning of the chief optical instruments. As he has made use of the calculations and formulæ given in his first volume, the amount of mathematics in this volume is kept very small. Sometimes, however, these formulæ are quoted without a definition of the symbols used, and the formulæ may not be intelligible without reference back to the first volume; a few extra words would often have made this reference back unnecessary; but it must be added that it is usually easy to guess the meaning of the notation.

The microscope is very fully dealt with, its

adjustment explained, and the resolving powers under different conditions of illumination obtained. Since the time when Abbe showed that there was a relation between the numerical aperture of a micro-objective and the resolving power of the objective, there has been continued controversy on the effects of form of illumination upon the results. To this controversy, Dr. Martin has himself made an important contribution. Whereas Abbe had considered the effects of the aperture of the objective upon the image of a grating when that grating is illuminated with a narrow beam, Martin has extended the analysis to beams of finite aperture, and has shown that in the focal plane, the use of extended aperture increases the approximation of the image to a true representation of the object. Dark-ground illumination and ultra-violet light are dealt with, as well as the ordinary illumination used for transparent objects. Altogether some sixty pages are devoted to the treatment of the microscope.

Of all the productions of science, the micro- and photographic objectives must surely stand among the first for the ingenuity displayed in their design and the patience entailed in the calculations by which they have been perfected. When one realises how large some of the aberrations can be in an uncorrected objective, and the number of errors that have to be eliminated, it would at first sight appear to be hopeless to expect to be able to make lenses that shall be even moderately good. Indeed, when the magnitude of the problem that the designer of either of these lenses has to face is realised, the success that he has obtained seems almost a miracle. The conditions that have to be fulfilled for the elimination of the several aberrations are here explained, and the methods whereby these conditions are more or less fulfilled by the designers in the various types of objective, are briefly described. By the use of new glasses, especially the barium crowns, and by using a number of separated lenses, every surface of which is made to add its contribution to the final result, the designer has balanced error against error, and has achieved the seeming impossible. The modern rapid photographic lenses are usually developed from the Cooke lens, which consisted of a concave flint lens between two separated barium crown convex lenses. This gave a remarkably good image with a fairly large aperture. By replacing the back component by a cemented doublet, the well-known 'Tessar' lens, working at $f/4.5$, was obtained; and by using two

separated lenses, the Taylor-Hobson anastigmat working at an aperture of $f/2.5$. When the perfection of the images yielded by these lenses is remembered, these are truly wonderful results.

A question of very considerable commercial importance is the amount of light that can be obtained through a given optical system. When it is realised that more than ninety per cent of the light of the arc is lost in the projection of the ordinary kinematograph film, the saving in the light bill that might be effected by an improved method of projection is obvious. These facts are sufficient to emphasise the value of the chapter on the photometry of optical systems, in which the different types of illuminating system are dealt with and the formulæ for the brightness of the images are found, not only for the kinematograph but also for the lantern, the episcopes and the searchlight. This subject—light transmission through an optical system—is one that is dealt with very inadequately in most optical textbooks, and yet it is one of fundamental importance in many practical applications of optics.

At the end of each chapter are collected the references from the text, forming a short bibliography to the subject-matter of the chapter.

The clear and concise treatment of his subject by Dr. Martin will make this book one of great value to every designer and maker of optical instruments, as well as to many users of the instruments specially treated. It is clearly printed, has good diagrams and is remarkably free from errors.

Human Physiology

Starling's Principles of Human Physiology. Sixth edition edited and revised by Prof. C. Lovatt Evans. The Chapters on the Central Nervous System and Sense Organs revised by Prof. H. Hartridge. Pp. xiii+1,122. (London: J. and A. Churchill, 1933.) 24s.

THE service rendered to British physiology by Prof. Starling will never be forgotten by his colleagues and students. His technical skill was of such an exceptional order that he was rightly styled on the Continent an arch-experimenter. The constructive character of his researches and the enthusiasm with which he presented his ideas were always the wonder and joy of his listeners. He will, however, be remembered by most as a teacher of physiology; his demonstrations were truly marvellous, while his lectures were almost as vivid as demonstrations.

Present-day students are fortunate in that Prof. Starling's influence did not cease with his death in 1927, but that the message of physiology, as a faith based on laboratory experience, may still be conveyed to them in his textbook of physiology. Starling's handbook very quickly established the premier position by virtue of its experimental outlook whereas, previously, physiological textbooks too often provided a mere top dressing of real physiology to a morphological basis. During Starling's life, the small students' handbook developed, in four editions, into the standard textbook of physiology.

Needless to say, students treating physiology from the purely examination point of view were sometimes alarmed by its attainment to a textbook of a thousand pages. Starling, who was also capable of seeing every point of view, sympathised with this type of student and devoted much pains to eliminating sections on morphology, etc., to keep the book within bounds. The enormous advances in physiology and its related sciences in the beginning of the present century rendered the expansion of what was now the leading textbook to its present dimensions. Physiology was advancing on many fronts, and specialisation was proceeding at such a pace, that Starling handed over the section on the nervous system and special senses to Prof. Hartridge. This proved to be a wise and necessary step and has resulted in a great improvement to a good work. This arrangement has been retained in the two last editions, and Hartridge has spared no pains in bringing these sections up to date, as may be seen from the accounts of conditioned and other reflexes.

Even so, a textbook which so evenly reveals the inspiration of the master, might soon relapse into senescence in any modern scientific subject. Physiology has been fortunate in the preservation of this textbook by the very careful revision it has been subjected to by Prof. Lovatt Evans. It is a hard task to maintain so large a textbook thoroughly up to the date of publication, but this was achieved very successfully by Prof. Evans in the fifth edition. In the new sixth edition he has further improved the work by introducing new sections of present-day interest and has rearranged other sections for the attainment of a more normal sequence. For the purpose of broadening the basis of authority, and for the assistance of students who wish to extend their reading, certain important references have been introduced which are properly placed as footnotes. This addition has

entailed an enormous amount of work and the intention to limit the number of references to the most important is to be commended.

There can be no doubt that this excellent work continues to maintain its pre-eminent position among textbooks in physiology. The book will retain its appeal to students in physiology and related subjects, and the present extensive revision should make it a useful refresher for medical men.

Insect Studies

- (1) *Colony-Founding among Ants: with an Account of some Primitive Australian Species.* By Prof. William Morton Wheeler. Pp. x+179+18 plates. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1933.) 11s. 6d. net.
- (2) *The Senses of Insects.* By Dr. H. Eltringham. (Methuen's Monographs on Biological Subjects.) Pp. ix+126. (London: Methuen and Co., Ltd., 1933.) 3s. 6d. net.

(1) COLONIES of ants may be formed by independent females, by several co-operating females, by the swarms of existing colonies, by females enslaving workers or even taking the nests of other species to rear their young, and by several variants, often extreme, of such social parasitism. Wheeler here discusses the independent method of colony formation and contrasts it with that in the bees and wasps. His new material was found in Australia on the Harvard Expedition of 1931-32, where the primitive ponerine ants form 25 per cent or 300 out of the 1,200 known species of ants.

The species especially observed are considered in respect to their morphology, taxonomy and habits, and the theme is made agreeable by well-chosen illustrations. The queen is usually different from the male and the worker, but there is quite a number of genera in which the female is not appreciably different from the workers—"ergatomorphic" as she is termed. For the most part, there is a limited number of workers in the ponerines, often less than a hundred, attached to the nest, so that any conception derived from the common ants of the northern world must be forgotten.

The small size of the ponerine females as contrasted with their workers is emphasised. They are evidently poorly endowed with fat and wing musculature that might be used in rearing their broods. The young might feed on one another, as

is common in many animals, and the mother might even prolong her own life by eating her brood. Wheeler now produces strong presumptive evidence that the normal behaviour in the *Ponerinae* is for the female ants to leave their nests from time to time and to forage for their first brood. They thus retain a primitive or archaic method of colony-formation.

Then follows a sketch of the proformicid ancestor and its habits, some instructive observations on the relations of ants to other Hymenoptera, and a discussion of this independent method of colony-formation. This little book of researches concludes with a classification of colony-formation and a bibliography. It is most illuminating, as indeed are all the observations of this our most philosophical of entomologists.

(2) Dr. Eltringham, who is known for his researches on the senses of insects, gives a simplified account with good figures of the organs of vision, hearing, taste and smell. Vision, the author's own speciality, is altogether excellent, but the rest is mainly a summary of other peoples' researches, such as is usually to be found in textbooks. He adds to this the bibliography from which his summary of the subject is drawn. The impression left on the reader is the small amount that is really known on the senses of insects and their immense possibilities for further study.

Because insects are often unpleasant to man and injure his crops, it has become the fashion to ask for practical results from entomologists, usually how to kill insects in the cheapest manner. The insect itself is neglected and its mental equipment, sense and psychology are regarded as of no importance, whereas the mental equipment of insects is in some respects as high as, or even higher, than that of man and must profoundly affect their actions. Research is clearly desirable, and it varies from minute morphological and experimental work in laboratories to the field observations of keen naturalists.

Mapping from Photographs

Photogrammetry: Collected Lectures and Essays.

Edited by O. von Gruber. Translated from the German original by G. T. McCaw and F. A. Cazalet. Pp. xii+454+55 plates. (London: Chapman and Hall, Ltd., 1932.) 30s. net.

THIS very substantial volume treats entirely of the construction of maps from photographs. It is stated in the editor's preface that

the work has been compiled mainly from lectures delivered during the sixth vacation course on photogrammetry which was held at Jena in 1929. The translators remark that this is the first of German books on the subject to be translated into English. Of the seven contributors, five are connected with the deservedly famous firm of Carl Zeiss, of Jena; we shall, therefore, find the Zeiss point of view, on any debatable points, very ably presented. The largest contribution is that made by Dr. Otto von Gruber.

The plan of the book includes a short chapter on the general aims and problems of the method, which divides itself naturally into ground photogrammetry and air photogrammetry; then we have a chapter, thorough but difficult, on the geometrical bases of the subject; then chapters on the rendering of details in photographs and on some Zeiss lenses; and then a long account of rotating disc shutters and a description of Zeiss air cameras. R. Finsterwalder gives an interesting chapter on a portable phototheodolite and its use on the Alai-Pamir expedition of 1928.

Those interested in the subject, however, will probably turn with the most lively anticipation to the longest two chapters, each of a hundred pages; one, by Dr. Willi Sander, on the development of photogrammetry with reference to plotting from two photographs, and the other on automatic plotting apparatus, by Dr. von Gruber himself. It is stated that Dr. Sander's chapter "aims at clearing up the questions of priority in photogrammetrical discovery". It is not easy, with the best will in the world, to assign due priority in matters of this kind, or to estimate the importance of the successive inventions. The historical chapter in question is a valuable summary and is thoroughly authoritative when it deals with the descriptions of the various inventions connected with the firm of Zeiss. With regard to work and inventions developed elsewhere, there is much information gathered together with great industry. But it is possible that the picture might have been presented somewhat differently if the account had been written by another authority. Thus, with reference to stereo-photogrammetry, priority is given to Pulfrich for his stereocomparator, of which the description was first published in 1902. But Fourcade is known to have read his paper at the Institute of Surveyors of the Transvaal in October 1901. Earlier still, Deville, as is mentioned on p. 177, published a paper, in the *Transactions of the Royal Society of Canada*, "On the Use of the

Wheatstone Stereoscope in Photographic Surveying", in 1896; and it is believed that Fourcade began his work on the subject in 1897.

However, if we make allowances for the point of view, this is an important and useful book, well illustrated, well printed and well indexed, a valuable work of reference on a difficult technical study, of which all surveyors must take account. The translators are to be congratulated upon the success of their laborious task; the English, in general, reads quite easily.

The Cotton Effect

The Cotton Effect and related Phenomena. By Dr. Stotherd Mitchell. (Monographs on Modern Chemistry.) Pp. vii+92. (London: G. Bell and Sons, Ltd., 1933.) 7s. 6d. net.

RECENT work on optical rotatory power has directed attention to the importance of the phenomena which were observed in certain coloured tartrates by Cotton in 1896, namely: a maximum ellipticity and a zero rotation interposed between positive and negative maxima, giving rise to a loop in the region covered by an absorption band. Dr. Stotherd Mitchell's monograph is therefore very welcome, since it contains an attractive review both of the experimental work which preceded Cotton's observations and of subsequent experiments with other optically active compounds containing absorption bands of suitable wave-length and intensity.

The earlier pages, leading up to Cotton's work, are of real value in recalling the origins of the fundamental phenomena of optical rotation and dispersion. References are given throughout, but would have been of greater value if in every case the date had been quoted, and the reference carried back to the original text instead of to reprints such as Ostwald's "Klassiker", or the "Oeuvres complètes" of Arago and Fresnel. The part which Biot played in the discovery of optical rotatory power also appears to have been underrated, if we accept the views of Longchambon that "Arago did not distinguish sharply between rotatory polarisation and chromatic polarisation", and that it was Biot rather than Arago who first established the laws of polarisation.

Recent measurements of circular dichroism are reviewed in somewhat full detail in the middle chapters, which are central in importance as well as in position; but these lead up to a chapter on

asymmetric photochemical action, which describes the successful experiments of Werner Kuhn and of the author, in producing optically active products by the selective destruction of racemates under the influence of circularly polarised light. The problem of the origin of optically active compounds in Nature is discussed, and the conclusion is drawn that no 'vital force' or living agency is needed for this purpose, since it has been shown that there is an excess of one type of circularly polarised light on the surface of the earth, which might enable this method of resolution by selective destruction to take place spontaneously.

The monograph is well written and attractively presented; it will be welcomed by many workers who are interested in the group of phenomena with which it deals.

T. M. LOWRY.

Electrical Communication

Telling the World. By Major-General George O. Squier. (A Century of Progress Series.) Pp. xi+163. (Baltimore, Md.: The Williams and Wilkins Co.; London: Baillière, Tindall and Cox, 1933.) 5s.

THIS book tells the story of electrical communication, and shows how the entire science has been built up on a few fundamental facts. The first chapter tells the story of electricity and magnetism, beginning with Gilbert and ending with Hertz and Marconi. The chapter is well written and General Squier has chosen the names of the world's men of science to whom he pays honour judiciously. Some of the equations given are perhaps too mathematical for many readers—it is not everyone who knows what curl H means.

In Chap. ii the history of the telegraph is given. It concludes with an account of Squier's own discovery that many messages can be sent along a wire simultaneously. The chapter on the telephone ends with the discovery that six or seven telephone messages can be sent at the same time over one pair of wires.

The account of radio engineering begins with Hertz and ends with Marconi and Franklin. The final chapter gives the history of the U.S. Signal Corps, and contains much novel matter. In this connexion the author has made several notable inventions. For example, he invented the method of using trees as antennæ. Wired-wireless telephony, another of his inventions, is in world-wide

use. His invention of the 'monophone' is of importance at the present time as it will relieve the pressure for more channels for broadcasting in the air. He shows how it is possible to send out a number of different 'sound' programmes over the telephone loop circuits emerging from the telephone exchanges. This is accomplished by burying the antenna of the high frequency transmitter in the cable group at the telephone central office in place of erecting it in the usual way. The energy is in this way transferred to the subscribers' loops and conveyed to their homes, where the sound programmes can be reproduced without disturbing in the slightest the ordinary telephone service. We do not like the new words for the radio art which the author gives in an appendix.

The book is nicely got up and printed. Under their motto *sans tache* (without blemish) the printers—the Waverley Press—publish the names of their operators, including those in the Proof Room. The names of several scientific workers, however, are spelt wrongly in various parts of the book.

Genesis of Magmatic Rocks

Igneous Rocks and the Depths of the Earth: containing some Revised Chapters of "Igneous Rocks and their Origin" (1914). By Prof. Reginald Aldworth Daly. Pp. xvi+598. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1933.) 30s. net.

AS pointed out by Teall more than thirty years ago, "The state of advancement of a science must be measured, not by the number of facts collected but by the number of facts co-ordinated". Judged by this standard, there is much to be accomplished before petrogenesis can be ranked as a science, for the majority of the accumulated observations still await co-ordination. This second edition of Prof. Daly's book on the igneous rocks will be welcomed, however, as a notable advance towards this ultimate goal.

The first general statement of the author's "eclectic theory" appeared in "Igneous Rocks and their Origin", published in 1914, and in the preparation of the second edition of the book he has had the benefit both of his own increased experience and of the new facts which have been discovered during the intervening twenty years or so. The recent advances in petrology have necessitated a complete rewriting of the book; many new facts have been incorporated and, although in its

broader lines the general theory remains essentially the same, various modifications have been introduced. It is remarkable how many of the hypotheses put forward by Daly in 1914 have come to be the accepted facts of to-day.

Daly believes, and rightly so, that, in the study of igneous processes, the petrologist cannot rely entirely on his own observations but must borrow constantly from the geophysicist and cosmogonist. The origin of magmas lies somewhere in the "mysterious depths", and it is impossible to formulate any theory of the genesis of magmatic rocks without taking into account the physical and chemical state of the earth's interior. His belief in the importance of this cosmical aspect of petrogenesis has led to the modification of the title.

The book is divided into three parts, each complete in itself but together forming an evolutionary sequence in the development of the theory. The first part is devoted entirely to a statement of the facts which call for explanation, and is of great value both to the student and to the research worker. The chapter on the physical properties of rocks is especially valuable in this respect. The general theory is developed in the second part, which deals in considerable detail with certain cosmical aspects of the subject. The necessity of a contracting earth as a necessary condition for abyssal injection is questioned and the author is inclined to ascribe a more important rôle to continental migration.

The distinction between igneous activity in Archean and post-Archean times and the predominant part played by melting and assimilation in the genesis of igneous rocks is the central theme and has been, in great part, justified by recent research.

Part 3 consists of an application of the general theory in the case of the different igneous rock "clans", and is probably more open to dispute than either of the preceding sections. Altogether, there is scarcely a single phase of igneous activity which is not dealt with somewhere in the book and, although petrologists may disagree with many of the conclusions, they require careful consideration. As the author himself points out, any comprehensive work on petrogenesis is only a report of its author's own synthetic thought, and whether the theory is right or wrong this book cannot fail to have a far-reaching influence and stimulating effect on the investigation of igneous petrology.

W. Q. K.

Progress Reports in Biochemistry

Annual Review of Biochemistry. Edited by James Murray Luck. Vol. 1. Pp. vii+724. Vol. 2. Pp. vii+564. (Stanford University, Calif.: Stanford University Press; London: H. K. Lewis and Co., Ltd., 1932, 1933.) 5 dollars each.

IN no branch of science is the number of publications increasing more rapidly than in biochemistry, and it is already hopeless for a worker to try to keep in touch with the original literature, or even the abstracts, without an undue expenditure of time. The Chemical Society rendered inestimable service to chemists when it began its "Annual Reports" some twenty-nine years ago; these include a section on the progress of biochemistry, generally the work of two authors who deal with the animal and the plant world separately. The space so available is to-day quite inadequate and therefore a warm welcome awaits this new venture, which is intended to present reviews of the current developments in five-and-twenty to thirty of the major fields of interest. Two annual volumes are before us, under the auspices of the Stanford University Press with the support of the Chemical Foundation, and edited by J. M. Luck. Their price, having regard to their utility, is reasonable.

The 1931 volume contains thirty reviews, that for 1932 is content with twenty-five. They are in English throughout, but the authors are drawn from Europe as well as the United States and are all well conversant with their subjects.

It is a moot question, discussed in the preface to the second volume, whether such reviews should take the form of annotated bibliography or of critical review. For ourselves we prefer the review. It can scarcely be exhaustive when based on the work of a year or perhaps two, but even in a subject which is making such rapid progress, it is always possible to take stages which are ripe for summation and criticism. It is within the power, as it is also the duty, of the expert to guide the student in this manner even at the risk of bias which, if exposed as erroneous, can be as frankly corrected in a subsequent year.

Annotated bibliography, which is far too popular at the moment, leads the reader nowhere and fails to hold his interest. Critical reviews are valuable, not so much for the expert in the particular narrow field, but for the researcher in some other section, reading to enlarge his horizon, to correlate and to realise the applications of a discovery to his own investigations. By such means,

wider progress is facilitated, the special is aided to become more general.

If there is over-production of commodities, it is certain that there is an even greater over-production of scientific papers, particularly in the biochemical field; many of them based on faulty or incomplete technique or published hastily. The experienced critic can do a great service in sifting these, and though, being human, he may err occasionally in his choice, the harm done is small for the true facts are bound to emerge in time whilst the false may cause much wasted time whilst it prevails.

We have stressed this point since constructive criticism of the "Reviews" is invited, and do so particularly because we believe these reviews are going to have a steadily increasing use in shaping and facilitating the course of future work. Both types of review, the critical and the biographical, are contained in the volumes, and they are necessarily uneven in merit though it would be invidious to particularise.

Some idea of the difficulty which confronts the author of a review and the magnitude of the task of a would-be informed research worker, is evidenced by some facts relating to that very fashionable subject, the vitamins. During 1932 at least a thousand papers dealing with them were published. There has been progress in detail, some definite progress in fact, but it can be summarised in 36 pages.

There is almost as much activity in the field of sugar chemistry, in spite of the fact that the broad outlines are well established and the principal objectives of the work of recent years now appear within reach. Even the complete or nearly complete solution of all the structural problems, which is such a creditable chapter in the annals of organic chemistry, does not mean an end to sugar chemistry. It has made it possible to attack some of the more pressing problems of metabolism, in particular those which concern the mechanism of biological sugar degradation.

It would serve no purpose to indicate the individual reviews or their authors except to express the gratitude that their colleagues must feel towards the many distinguished men who have given their time to writing them. With its policy of fluidity, with its intention to include new topics in replacement of the old, the "Annual Review" is going to be as indispensable as the telephone-book. We may add in conclusion more than a word of praise of the setting of the type and the formulæ, particularly the more complex. E. F. A.

Short Reviews

Anthropology and Archæology

- (1) *The Andaman Islanders*. By Prof. A. R. Radcliffe Brown. Second edition. Pp. xiv + 510 + 20 plates. (Cambridge: At the University Press, 1933.) 30s. net.
- (2) *On the Aboriginal Inhabitants of the Andaman Islands*. By Edward Horace Man. With Report of Researches into the Language of the South Andaman Island, by A. J. Ellis. Pp. xxxii + 224 + 44 - 73 + 18 plates. (London: Royal Anthropological Institute, n.d.) n.p.
- (3) *The Nicobar Islands and their People*. By Edward Horace Man. With a Memoir contributed by Sir David Prain. Pp. x + 186 + 32 plates. (London: Royal Anthropological Institute, n.d.) n.p.

(1) PROF. RADCLIFFE-BROWN'S study of the Andaman Islanders, which was first published in 1922, is reprinted without change, save for the addition of a few pages on the Andaman languages. The author has also written a new preface, in which he explains more fully the principles upon which he worked, and expounds his view that the aim of social anthropology is the study of 'social integration'.

(2) The Royal Anthropological Institute has done good service to anthropology in reprinting the monograph on the Andaman Islanders by the late E. H. Man, which for long was regarded both for its method and its accuracy as a model ethnographical treatise. First published in 1885, and long out of print, it remains an invaluable record of a remarkable people at a comparatively early stage of their more intimate contact with Europeans.

(3) Papers on the peoples of the Nicobars contributed by the same author to the *Journal of the Royal Anthropological Institute* have been collected in this volume. The material as originally presented has been corrected and supplemented by the author's subsequent notes and additions. Sir David Prain has contributed a memoir of the author, in which he does full justice to his services to science, both as an anthropologist and as a helper in the research work of others.

The New Knowledge about the Old Testament.

By Sir Charles Marston. Pp. 182 + 6 plates. (London: Eyre and Spottiswoode, Ltd., 1933.) 5s. net.

IN promoting excavations on archæological sites in Palestine, Sir Charles Marston, who has earned the gratitude of all archæologists and students of Biblical research, has shown himself throughout a staunch supporter of tradition, as against the destructive efforts of textual criticism. Here he summarises the inferences which in his view may be drawn from recent excavation in the Near East in corroboration of the Biblical narrative. Of this material the evidence for the flood at Ur and

Kish are generally well known; but the implications of Prof. W. Garstang's discoveries at Jericho, which fix the fall of the city before Joshua at 1400 B.C. with but little margin of error, and the finds of Ras Shamra and the new light they throw on the use of an alphabetic script and the problem of monotheism, are not yet so widely appreciated. Sir Charles argues forcibly for the earlier dating by two hundred years of the Exodus and the entry of the Hebrews into Palestine, as a solution of the difficulties which arise in other parts of the Biblical text on the later dating. His explanation of the silence of the Hebrew records in regard to subsequent events mentioned in the Tel el Amarna letters is ingenious, and in the light of later history, plausible.

Mexico before Cortez: an Account of the Daily Life, Religion and Ritual of the Aztecs and Kindred Peoples. By J. Eric Thompson. Pp. x + 298 + 34 plates. (New York and London: Charles Scribner's Sons, 1933.) 10s. 6d. net.

THIS small but compendious volume is a companion to "The History of the Maya", published by Mr. Thompson in collaboration with Dr. Gann two years ago. Together the two books form an excellent introduction to a knowledge of the history and civilisation of Central America up to and at the time of the Spanish conquest. The later book is perhaps a little more popular in tone, and the interest of its matter slightly less, if the reader is archæologically inclined. Mr. Thompson describes the chief characteristics of Aztec culture—social and military organisation, arts and crafts, religion, calendar and feasts, and temples and tombs. For the last section he surveys briefly the chief results of archæological exploration in Mexico up to the date of writing. For the other sections, he has made a full and judicious use of the writings of the chroniclers, especially in describing the most prominent feature in Aztec culture, at least as known to us, namely, their addiction to human sacrifice. Mr. Thompson rejects 'diffusion' though he admits that there may be something to be said for the spread of cultural influence from the Pacific.

Biology

Le Haut-Jura neuchâtelois nord-occidental. Par Prof. Henri Spinner. (Materiaux pour le levé géobotanique de la Suisse, Fascicule 17: Commission phytogéographique de la Société helvétique des Sciences naturelles.) Pp. 197 + 8 plates. (Bern and Berlin: Hans Huber, 1932.) 12 francs; 9.60 gold marks.

THIS contribution to the geobotany of Switzerland (the seventeenth in the series edited by Rübel and Brockmann-Jerosch) deals with an area on the western border of Switzerland of an altitude not exceeding 1,334 m. A full account is given of the geological, edaphic and climatic characteristics of

the area. The vegetation types include forests of conifers (*Picea excelsa* pure or mixed with *Abies alba*) and deciduous trees, wooded pastures, meadows, hydrophilous formations, peat-bogs, formations on rocks, screes and stony ground, and cultivated land. These are dealt with in detail, the descriptions and lists being illustrated by photographs reproduced as plates and text-figures. A large-scale map of the vegetation zones of the Lac des Taillères indicates the detailed nature of the survey. The most striking feature of the publication is, however, a folding map in a dozen colours of the whole area on the scale of 1:25,000. The map not only shows the distribution of the types of vegetation, but also, by means of symbols, that of the more important species.

The pollen-grain analyses of peat deposits has provided a basis for an account of the evolution of the vegetation. The plant life was completely destroyed during the Riss glaciation and without doubt also at the return Würm glaciation. About 15,000 B.C., *Pinus montana* and birches occupied ground left by the retreating ice. Later (about 12,000 B.C.) *Pinus silvestris* entered the area and was followed (11,000-9,000 B.C.) by hazel, oak and hornbeam. Other broad-leaved trees gave a more mixed forest from 9000 until 6000 B.C., while the fir, spruce and beech were late immigrants.

W. B. T.

Handbuch der biologischen Arbeitsmethoden. Herausgegeben von Prof. Dr. Emil Abderhalden. (1) Lief. 392. Abt. 6: *Methoden der experimentellen Psychologie*. Teil D, Heft 3 (Schluss): *Vergleichende Tierpsychologie*. Pp. 233-427+ix. 11 gold marks. (2) Lief. 395. Abt. 9: *Methoden der Erforschung der Leistungen des tierischen Organismus*. Teil 6, Heft 2: *Methoden der Meerwasserbiologie*. Pp. 195-366. 10 gold marks. (Berlin und Wien: Urban und Schwarzenberg, 1932.)

(1) IN this memoir are recorded the methods and results of the principal lines of experimentation designed to test observation, memory and the reactions of animals. More than half the work is devoted to the consideration of vertebrate animals, fish, rats, dogs, monkeys, etc., and the rest of the work, which is perhaps of more particular interest to zoologists, to the invertebrates. Experimental work on the reactions of the latter is considered in systematic order, beginning with the Protozoa and passing successively to the echinoderms, annelids, molluscs, crustaceans, arachnids and insects—a very useful summary of present knowledge.

(2) This is a useful account of the various devices which have been found serviceable in the rearing of marine fishes either in scientific experiments or in economic culture. The methods of collection of eggs, fertilisation, the various forms of aquaria and other breeding vessels and the food of fish larvæ are first considered. In the next twenty pages are described some of the principal

methods applicable in the laboratory to the keeping or rearing of marine fish for experimental work; for a score of different species the technique which investigators have found most successful in each case is set forth in a clear and helpful manner. The concluding part of the work is devoted to economic fish culture and cognate matters.

Opere di Paolo Celesia. Serie scientifica. Vol. 3, Serie 1: *Nuovi studi biologici*. Pp. viii+532. (Roma: Libreria di Scienze e Lettere, 1932.) 35 lire.

THIS is a further instalment of the biological studies of Paolo Celesia, who died in Rome in 1916 at the age of forty-four years. The first volume of his biological studies appeared in 1923 and contained eleven original memoirs together with reprints of a number of reviews. The present volume is a collection of about ninety articles or notes written during the author's last years, which record his views and reflections, with the place and date of writing. The notes range in length from a page to twenty pages, and from their manner of production have no continuity, but those on cognate subjects have been grouped to form seven chapters. The principal are on life and death, on sexuality and reproduction and on hermaphroditism, which together occupy about two-thirds of the volume. These are followed by chapters on asymmetry and on the abyssal fauna. Many of the notes are in the form of critical or speculative considerations arising out of the author's reading. The volume is a memorial of the author's contemplations on a considerable range of subjects.

An Introduction to Zoology: through the Study of the Vertebrates with Special Reference to the Rat and Man. By Prof. Zeno Payne Metcalf. Pp. xix+425. (London: Baillière, Tindall and Cox, 1932.) 20s.

AIMING at the education of the beginner in zoology, this "Introduction" selects a single mammalian type, a rat, the functions and related structures of which are considered in detail. Towards this central theme, by noting contrast or similarity of parts, are drawn a number of other vertebrate animals, but apart from this and an introductory chapter of 14 pages, no account is given of the characters or relationships of invertebrate and vertebrate groups. On the other hand, stress is laid upon discussions of more general subjects, such as locomotion in animals, heredity, animal behaviour; and almost one-third of the book is given up to a simple treatment of philosophical zoology.

The book has good points; it is concise, is simply written, and contains some instructive diagrams, but to our mind its deliberate plan fails in that it lacks that minimum solid substratum of comparative zoology upon which a sound superstructure of general principles can be erected.

J. R.

Chemistry

Hydrochemische Methoden in der Limnologie: mit besonderer Berücksichtigung der Verfahren von L. W. Winkler. Von Dr. Rezső Maucha. (Die Binnengewässer: Einzeldarstellungen aus der Limnologie und ihren Nachbargebieten, herausgegeben von Prof. Dr. August Thienemann, Band 12.) Pp. x+173. (Stuttgart: E. Schweizerbart'sche Verlagsbuchhandlung (Erwin Nägele) G.m.b.H., 1932.) 18 gold marks.

IN the rapid advance of fresh-water investigations during the last two or three decades, chemistry has played an important part and many analytical processes which are applicable in the field have been devised. This book gives an account of the various methods employed in a complete water analysis. Particular attention is devoted to the determination of dissolved oxygen and to the various precautions and modifications necessary in the application of the Winkler technique. Methods are considered for the determination of carbonate, silicate, phosphate, sulphate, chloride and iodide, of calcium, magnesium, potassium, sodium and iron, and of the organic substances in water and their decomposition products.

The volume is useful in that it brings together accounts of methods which are scattered in the literature, and it offers many practical suggestions which should result in the avoidance by the modern limnologist of mistakes and misapplications in chemical technique.

L'Azéotropisme: la tension de vapeur, des mélanges de liquides; Bibliographie. Par Maurice Lecat. Pp. viii+134. (Bruxelles: Maurice Lamertin, 1932.) n.p.

MAURICE LECAT has compiled a bibliography of the phenomenon of azeotropism. The main subject is the formation of mixtures of constant boiling point, which was studied with so much interest and success in the case of aqueous acids by Roscoe in 1880; but other papers, dealing with the surface tension of mixtures of liquids, have also been included in the three lists which compose the bibliography. The principal list is in the form of an alphabetical index of authors, but there is a second list in order of dates and a third list under the titles of different journals. These supplementary lists refer back to the principal list, to which cross references are given by means of serial numbers, running up to 1,283 in the final entry under the name Zmaczyński. The author is himself a distinguished worker in this field, since his own writings are responsible for 49 of these numbers; but he has rendered an important service to science and industry by bringing together so large a collection of references, from Dalton (1813) to the autumn of 1932. The subject index corresponding to the bibliography now under review consists of a series of "Tables of Binary Azeotropes" of which 14 have already been issued and others are in preparation. T. M. L.

Elementary Organic Chemistry. By B. C. L. Kemp. (Dent's Modern Science Series.) Pp. ix+356+8 plates. (London and Toronto: J. M. Dent and Sons, Ltd., 1933.) 5s.

MR. KEMP's book is intended for pupils preparing for higher certificate, university scholarship, Army entrance and 1st M. B. examinations. A good feature is the inclusion of practical work, each experiment being capable of performance by a pupil of average capacity within the limits of one hour. The practical directions are concise, but include necessary details, and questions are provided.

The text is clearly written and reasonably up-to-date, although the formulæ of the sugars require modification. The use of arrows instead of equals signs in equations encourages young students to leave equations unbalanced. Since some space is devoted to a discussion of the electronic theory of valency, it is a pity that the obsolete structural formulæ for the nitro-compounds are given on pp. 154 and 250: the correct formulation is easily understood by elementary students. The formula of ammonium chloride on p. 272 is also incorrect.

Engineering

Industrial Electric Heating. By N. R. Stansel. Pp. vii+444. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1933.) 31s. net.

WE agree with the author that thermal engineering requires some knowledge of all the industrial sciences. The use of electric heat is no longer confined merely to the thermal units it conveys. It is now considered as a method of manufacture which brings great scientific aid for the production of better products. The milk bottle has a small unit value but a life of severe service. Its life depends in a large measure upon the proper application of heat to remove the strain from the glass. The more nearly perfect this operation the greater the insurance against breakage in service. The temperature cycle—almost as exact as a laboratory standard—gives a durability to the milk bottle that justifies the name 'unbreakable' bottle sometimes given to it.

During a study of a wide range of electric heat installations the comments of operators of that type of equipment were noteworthy. Electric heat can be applied with great ease wherever the location may be or whatever the quantity required. In the shoe-making industry the heating units may be smaller than a finger but in large steel melting furnaces they may weigh many tons.

The author writes interestingly and gives good descriptions of "resistor" and arc furnaces. The chapter on the atmospheres of "resistor" furnaces is instructive. It is stated that the volume of the gas at room temperature which is given off from an ingot of average steel when heated to 900° C. is nearly the same as the volume of the steel. Everyone interested in manufacture will find this book of interest.

The Measurement of Air Flow. By E. Ower. Second edition, revised and enlarged. Pp. viii+243. (London: Chapman and Hall, Ltd., 1933.) 15s. net.

THE accurate measurement of the mean rate at which a gas is flowing at any instant through a definite area or relative to a fixed body presents serious difficulties, but is of considerable importance in connexion with many scientific and practical problems. The first edition of Mr. Ower's book, in which various types of instruments used for determining air flow velocities were described and the theoretical basis of their design discussed, met a real need. Advantage has been taken of the new edition to make revisions and add certain new matter, the most important of which gives details of the German standard nozzle for measuring air flow along a pipe. A table of coefficients is given for various ratios of the area of the nozzle and the area of the pipe, and the limiting values of vd/v for which these coefficients are stated to be reliable, within an accuracy of 0.5 per cent, is given.

It is unfortunate from the point of view of the reader that the coefficient given in the table is not clearly defined, and the reader must refer to earlier pages to find a definition. He is likely to be a little embarrassed by the correct definition given on p. 74 not being apparently the same as that given on p. 105, but an examination of the mathematics given in the earlier part of the same chapter as that in which the instrument is described, will make the matter quite clear.

The book is well and suggestively written, is clearly illustrated and to the scientific worker the very complete bibliography will be of real value.

Wireless Over Thirty Years. By R. N. Vyvyan. Pp. xiv+256+16 plates. (London: George Routledge and Sons, Ltd., 1933.) 8s. 6d. net.

THIS account of 'wireless' by the builder of the pioneer stations of Cape Cod and Glace Bay, colleague of Marconi since 1900, protagonist of 'imperial wireless communications', and recently engineer-in-chief of the Marconi Co., is full of interest and colour; it will be widely read and enjoyed. A picture of Marconi's early and heroic work has not been readily pieced together from other sources; here it will be found vividly and satisfactorily drawn, with appendixes of technical detail. There are, among others, interesting and suggestive chapters on modern commercial stations, wireless in war—on land, at sea and in the air—and wireless to the rescue at sea. One of the most valuable chapters, since it contains financial data usually difficult of access, is that on wireless as a career, which merits assimilation by all who are interested in the place of the technical 'expert' in modern life.

No normal mind could have given full service to one great enterprise for thirty exciting years without the sustained stimulus of a loyalty which, from another angle, may be called partisanship.

The book is undisguisedly a "Marconi" book; were it anything else it would be far less enjoyable—the gain in scientific and technical balance would not offset the loss in warmth and colour.

Mathematics

Principles of Descriptive Geometry. By Dr. E. L. Ince. Pp. viii+152. (London: Edward Arnold and Co., 1933.) 8s. 6d. net.

DESCRIPTIVE geometry as an art is of great antiquity, but, as an exact science, it is comparatively very young, and this excellent volume is probably one of the first English works to deal with the fundamental principles of the subject. Hitherto authors have been content to discuss practical applications mainly, without any reference to the principles upon which such applications depend.

Dr. Ince's book, founded upon a course of lectures given to students of the Egyptian University, develops the subject in the true spirit of mathematics. The treatment is thoroughly sound and lucid, and the text is well illustrated with clearly drawn diagrams. The seven chapters culminate in the discussion of simpler polyhedra, curved surfaces being excluded from a first year course. As the author states, "There is one sure way, and only one, of learning descriptive geometry, and that is on the drawing board." An ample supply of interesting and practical exercises has therefore been provided in order to give the student a firm grounding in first principles. The book is a valuable addition to mathematical literature and should inspire a much-needed appreciation of the importance of the theory of descriptive geometry.

Differential and Integral Calculus. By Prof. J. H. Neelley and Prof. J. I. Tracey. Pp. viii+496. (New York: The Macmillan Co., 1932.) 20s. net.

To plan a course in the calculus satisfactory alike to the pure mathematician and the practical student is a problem of some difficulty. The authors of this volume, however, have shown how such a problem may be successfully solved. Here we have a really stimulating work adapted alike to general academic requirements and to those of technical students. Rigorous proofs of certain theorems have not been used, but all the necessary assumptions have been pointed out and the student warned to examine these suppositions more critically at a later stage.

The text is illustrated by the solution of many very interesting practical problems, and the diagrams, particularly those associated with multiple integrals, are exceptionally clear. These should lead to a thorough understanding of the analytical processes underlying the problems of multiple integration.

The book is well stocked with exercises for the reader to solve, and is excellently printed. It may be confidently recommended to all students of the calculus.

Vector Analysis. By Prof. H. B. Phillips. Pp. viii+236. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1933.) 15s. 6d. net.

THIS book has for its object the presentation of vector analysis in a form suitable for the study of theoretical electricity and hydrodynamics. The text is therefore devoted to a thorough analysis of vector fields, together with a consideration of those quantities which characterise each type of field. Fundamental operations and general properties of scalar and vector fields are excellently dealt with in the first seven chapters, thus providing a sound basis for the more advanced work on detailed analysis, properties of potentials and linear vector functions which follows.

The author has certainly spared no pains to accomplish his aim, and the book should prove extremely useful to students of physics, to whom a sound knowledge of vector analysis is essential.

Miscellany

(1) *A Scientist among the Soviets.* By Julian Huxley. Pp. vii+119. (London: Chatto and Windus, 1932.) 3s. 6d. net.

(2) *Russia: Market or Menace?* By Thomas D. Campbell. Pp. x+148+8 plates. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1932.) 7s. 6d. net.

THESE two pictures of Soviet Russia as seen through the eyes of a leading English man of science and a leading American agricultural engineer have an interest out of proportion to the brief stay which both of them made in Russia. In an eminently readable style both Prof. Huxley and Mr. Campbell contrive to convey some idea of the shifting Russian scene, and their impartial narrative and frequently trenchant criticism are the more convincing because of the obvious pains which both authors have taken to obtain a sense of perspective.

(1) Perhaps inevitably, a biologist comes to regard Russia as a gigantic scientific experiment, but in his first two chapters on the Russian atmosphere and on the compromise between medieval past and communist future, chaos and planned economy, expediency and principle to be found in Russia to-day, Prof. Huxley supplies evidence in support of his view. As Prof. Huxley reminds us, the Five Year Plan is only one of a succession of plans; its main interest lies in the evidence it affords of the introduction of a new spirit, the spirit of science, into politics and industry. In the stress which has been placed on the economic aspects of planning this fundamental scientific aspect has often been overlooked. He notes that orthodox communism makes no distinction between pure and applied science, but considers all science as being, in the long run, determined by economic needs.

(2) Mr. Campbell sets forth in a vigorous narrative some of the facts he learnt from personal contact and experience when on two visits to

Russia in January 1929 and in July 1930 to assist in the agricultural programme of the Soviet Government. His attitude is one of frank criticism but of generous appreciation of much that he saw, and his comments on the Five Year Plan make an interesting comparison with Prof. Huxley's experience. Mr. Campbell shrewdly notes the advantage which Soviet Russia possesses in beginning her major industrial development at a time when she can profit by the mistakes made by other industrial countries.

Thanks to adequate planning and care to secure the ablest technical assistance from abroad, Soviet Russia is providing herself with the most efficient and up-to-date machinery possible, and the main question that remains is whether an equally efficient personnel can be trained to operate that machinery within a short space of time.

Evolution and Redemption. By Dr. H. P. Newsholme. Pp. 267. (London: Williams and Norgate, Ltd., 1933.) 8s. 6d. net.

DR. NEWSHOLME in his previous book and lectures has stressed the vital significance of mind and soul, and in this, his latest work, he deals with the subject much more deeply and fully. He has made a valiant attempt in a most difficult field, for it is presumed that one of his aims is to reduce further the supposed antagonism between religion and science by putting forward a view of redemption, not only of humanity but also of the whole universe, assumed to be in need of it, which should fit in with modern views of evolution and even of relativity. An ingenious though not too convincing theory of evil and its origin and of the manner in which it will ultimately be exterminated is offered; but it must be regretfully admitted that much of it is sheer speculation sometimes bordering on the fantastic, and unduly tedious. It is assumed that matter, even in its earliest elemental form, has embryonic soul and spirit, that it can be contaminated with evil and thenceforth suffer from inertia, which seems to be a particular manifestation of evil.

The book should appeal to medical men interested in religious philosophy, but despite its tone of deep piety and earnest conviction it cannot be regarded as a very satisfying contribution to Christian apologetics. It is doubtless a very sincere attempt to clear up some of the difficulties, from the scientific point of view, of the Christian faith, but it is extremely hard to say whether this greater clarity has been achieved.

Physics

Infra-Red Photography. By Dr. S. O. Rawling. (Blackie's "Technique" Series.) Pp. x+57+12 plates. (London and Glasgow: Blackie and Son, Ltd., 1933.) 3s. 6d. net.

ALTHOUGH sensitisation by means of dyes was discovered by Vogel so long ago as 1873, a satisfactory explanation of the action of such dyes is

still wanting. The connexion between the constitution of the dye and its sensitising effect has not yet emerged clearly from the mass of data which has accumulated, and this probably accounts for the fact that it has taken so long to find dyes capable of sensitisation in the deep infra-red. That the search has been successful is due to the intensive research which has been carried out in the laboratories of the various large firms manufacturing sensitive material. Of one of these firms, Ilford, Ltd., Dr. Rawling, author of the little book under notice, is a member.

The account is written in a popular manner, the fundamental principles necessary for an understanding of infra-red sensitisation being carefully and clearly explained. After dealing with the characteristics of infra-red radiation, the infra-red materials and the method of handling them are described. The last chapter then deals with the various applications and is especially valuable. After describing the use of infra-red photography as a haze penetrator—the phase of the subject which has given rise to most of the astonishing photographs recently published in newspapers and magazines—reference is made to its use in deciphering censored documents, in astronomy, in photomicrography, in clinical work, etc. It is in connexion with scientific problems that the main uses will probably be found, and new applications are being made every day. It is likely that a new edition of the present book, incorporating such applications, will soon be called for.

Dr. Rawling has done his work well and the book, which is illustrated, should be in the hands of all interested in photography and its many applications.
T. S. P.

An Introduction to Acoustics of Buildings. By Dr. E. G. Richardson. Pp. 63. (London: Edward Arnold and Co., 1933.) 3s. 6d.

DR. RICHARDSON has produced a very useful and practical handbook. There always exists a tendency to attempt to pack too much information into a pocket volume, but the author has here selected his data well and wisely. The result is a handy and uncrowded little book, which contains almost all the information needful for a student who desires to make a successful attack on the problem of designing an acoustically successful hall, or amending the acoustic properties of an ill-designed room.

The different sections of the book deal with reverberation, the distribution of sound, absorbent materials, the insulation of sound, and hints on acoustic design. The simple principles developed are illustrated by practical examples and by tables giving the relevant properties of materials and other necessary data.

We might criticise mildly some of the definitions given in the introductory chapter—'pitch', for example, and 'intensity or loudness of a sound'; the author is evidently in a hurry to lead the reader into the adytum, and has no time to spare for the details of the entrance porch. These matters,

however, do not bulk largely in the structure of the book, and necessary slight amendments may readily be made in a second edition.
A. F.

An Outline of Atomic Physics. By Members of the Physics Staff of the University of Pittsburgh: Oswald H. Blackwood, Elmer Hutchisson, Thomas H. Osgood, Arthur E. Ruark, Wilfred N. St. Peter, George A. Scott, Archie G. Worthing. Pp. vii+348. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1933.) 21s. 6d. net.

WE do not as yet suffer from an excess of textbooks on atomic physics. As the authors remark, we have plenty of works "replete with equations and mathematical phraseology" designed for the use of specialists, and we have more than enough of works devoted to the uplift of the fireside reader. But there are signs that the flood is setting in. The present work is a series of critical studies of various aspects of atomic physics very fit to be put into the hands of an undergraduate student. An excellent picture of the state of physics in the late nineteenth century is followed by fourteen chapters which deal, in a manner designed to leave their readers wanting more, with the atomic nature of matter and electricity, the corpuscular nature of radiant energy, spectra, X-rays, radioactivity, molecular structure, relativity and astrophysics.

The book may be strongly recommended.

The Calculation of Heat Transmission. By Dr. Margaret Fishenden and Owen A. Saunders. Pp. xii+280. (London: H.M. Stationery Office, 1932.) 10s. net.

THERE is a very marked difference between the ease of approach to a practical problem in electricity, and the feeling of vagueness and uncertainty which oppresses one when tackling a problem in heat transfer. One of the fundamental difficulties is that of obtaining reliable information, and the authors, who have collected, in this very important book, the results of a great mass of experimental work "interpreting and comparing them—in the light of the fundamental principles of radiation, conduction and convection" have put workers in the science of heat very heavily in their debt. They have discussed a number of thoroughly practical problems, and their book should prove, not only an aid to the investigator, but also a stimulus to future experimental work.
A. F.

Geography and Travel

Peaks and Plains of Central Asia. By Col. R. C. F. Schomberg. Pp. 288+8 plates. (London: Martin Hopkinson, Ltd., 1933.) 15s. net.

To explore untrodden ways is the ambition of all who travel in the remoter parts of the world. Col. Schomberg in traversing the deserts of Central Asia found it impossible, notwithstanding his endeavours, to avoid the cities; but nevertheless in "Peaks and Plains of Central Asia" he shows,

by example, how much is still to be learned in the haunts of man along those Asiatic roads where others, though not very many Europeans, have passed before him.

Col. Schomberg's book is a record of two journeys of considerable duration, in 1927-29 and 1930-31, in Sinkiang, the modern province which comprises all the Chinese possessions in Central Asia and extends from the Gobi Desert to Asiatic Russia, its political and administrative centre being Urumchi. Starting from Kashgar he visited all the principal centres of population which lie around the central desert, some of them several times, and penetrated to outer Mongolia, crossing the Zungarian desert. In his second journey he went to Lop, and was able to observe the effects on the population of the recent diversion, after a thousand years, of the River Tarim to its ancient channel. The distress among the inhabitants caused by the change in the distribution of the water supply is an instructive comment on the history of civilisation in this land of dead cities.

Some of the districts visited by Col. Schomberg, such as Yulduz, Barkul, Sharasumé, are but little known; but in all there is a striking uniformity. Variations, indeed, are noted by the author; but they are mostly connected with food, the bazaar, and cleanliness. Col. Schomberg is a keen observer of differences of character, whether among the town-dwelling Sart or among the mountain nomads, Kirghiz, Kasak or Mongol; but he is tolerant of their peculiarities. His description of the Tungan, the Chinese Mahomedans, of whom too little is known, is welcome; while his high opinion of the Chinese administrator, notwithstanding the handicap of 'red-tape', is justified by his experience.

The attractive coloured illustrations are from photographs by Capt. George Sherriff.

The Empty Quarter: being a Description of the Great South Desert of Arabia known as Rub' al Khali. By H. St. J. B. Philby. Pp. xxiv+434+32 plates. (London: Constable and Co., Ltd., 1933.) 21s. net.

MR. PHILBY'S achievement in crossing the Rub' al Khali, "The Empty Quarter" of southern Arabia, of which he tells the story in this volume, is sufficiently well known to call for little further comment. It was a project which had been a cherished ambition for fourteen years, and it was an ill turn of fortune that the honour of priority should have gone to Mr. Bertram Thomas by the narrowest of margins. Mr. Philby's chronicle of strenuous exploration makes fascinating reading and, apart from its scientific value, is of permanent interest as a record of what may well be the last exploration on any considerable scale in Arabia by camel train. The author foreshadows the advent of the motor car.

The scientific results of the journey were considerable. Although the archaeological material collected was scant, and the ruins which had been

reported did not turn out to be what had been expected, but vast craters said to be formed by the impact of meteorites, the geographical observations, and especially the evidence of a vanished river system, hold out hope for the prehistorian in the future. They suggest the possible discovery of material far earlier than the Neolithic implements obtained on this journey. The geological, zoological and botanical materials are discussed in appendixes written by experts in the respective branches of science concerned.

Human Geography of the South: a Study in Regional Resources and Human Adequacy. By Dr. Rupert B. Vance. (University of North Carolina Social Study Series.) Pp. xiv+596. (Chapel Hill, N.C.: University of North Carolina Press; London: Oxford University Press, 1932.) 24s. net.

THE area of which this book treats comprises the thirteen southern States of the United States of America, from Virginia and Kentucky to the Gulf of Mexico and from the Atlantic to Texas and Oklahoma. This may be regarded as a distinctive human and cultural region although it embraces several physical units of distinctive character. Dr. Vance traces the relation between man and his environment, keeping his study to broad issues with a commendable absence of mere details of location and localised activity. He shows how the different phases in the peopling of his area still have their reflections in conditions to-day. The heritage of the frontier zone is submerged but not lost in the later plantation phase, while superimposed on these are newer industrial and agricultural interests.

The book is well documented and contains an exhaustive bibliography. It is a good example of the value of advanced geographical study in the understanding of human problems.

Commonwealth Bureau of Census and Statistics, Canberra. *Official Year Book of the Commonwealth of Australia.* No. 25, 1932. Prepared by E. T. McPhee. Pp. xxxii+894. (Canberra: L. F. Johnston, Commonwealth Government Printer, 1933.) 5s.

As a work of reference in regard to all aspects of Australian activity, this annual work is invaluable, and the present issue retains the qualities that have made the Commonwealth "Year Book" a pattern of what such reference volumes should be.

Descriptive notes frequently amplify the full statistical tables, which in many cases give for purpose of comparison the figures for several years, and in some aspects of Australian life comparative figures for other countries. The call for economy has curtailed some sections, but the editor has been successful in giving an immense mass of information and leaving no obvious blanks in his compilation. Several maps, including one of rainfall, add to the value of the work, and there is the usual list of books on Australia.

Technology

Timber Technicalities: Definitions of Terms used in the Timber and Correlative Trades and Wood Consuming Industries. By Edwin Haynes. Second edition, revised and enlarged by Thomas J. Stobart. Pp. vii+184. (London: Ernest Benn, Ltd., 1933.) 8s. 6d. net.

THIS book is a dictionary of terms used by foresters, timber merchants, agents, shippers, sawyers and others engaged in the cultivation and felling of trees, and in the sale and manipulation of timber. Although many of the terms are given in other dictionaries, their collection and arrangement in a book of convenient size for carrying about is a very distinct gain for the business people for whom it is primarily intended. It was originally published in 1921, and this, the second, edition has undergone some considerable revision.

In addition to the many terms described, there is a very useful list of contractions and abbreviations of terms used in the timber and shipping trades many of which have little significance to the uninitiated. Instances are, c.m., calliper measure; f.a.q., fair average quality; f.o.w. (Baltic trade), first open water; a/s, alongside; d.b.b., deals, battens and boards. There is also a comparative table of actual and nominal measurement of planed goods showing the gain for freight; a list of average weights per cubic foot of seasoned home-grown timber; a list of average weights of green and dry American lumber; a glossary of timber trade technical terms in English, French, German, Spanish and Swedish. Thus, in one of the terms of inferior quality timber we have English, Inferior Fifths; French, Rebut; German, Ausschuss; Spanish, Madera muy Ordinaria;

Swedish, Utskott. A bibliography of works on forestry completes the volume.

Der Glaszustand. Von Gustav Tammann. Pp. 123. (Leipzig: Leopold Voss, 1933.) 8.70 gold marks.

GLASS is unique in that it differs from ordinary crystalline solids on one hand and from liquids on the other. Some consider that in a descriptive sense it should be associated with supercooled liquids; others think that the lack of crystalline form in glasses is only apparent. The X-rays appear to disclose orderliness of atomic arrangement on a scale far too fine for the microscope ever to reveal.

Prof. Tammann's book brings under review a great deal of work carried out in his own laboratories at Göttingen during the last few years and forms an admirable appendix to his well-known book on "Aggregatzustände". The discussion of the properties of ordinary glasses of the silicate type is incidental rather than of set purpose. One of the main objects of the book is the presentation of the general properties of glass in the so-called softening range. For this reason the properties of substances such as piperin, selenium and salipyrin, not usually dealt with by the ordinary glass technologist, come under review. Viscosity, elasticity, volume-pressure relations, crystallisation velocity and refractive index phenomena are amongst some of the subjects discussed. An item of particular interest to physicists is the question of molecular rotation in the softening range.

The book is well produced and, within the limits prescribed by the author, of considerable value to all who are interested in the properties and constitution of substances which may exist in a vitreous form.

Forthcoming Books of Science

Agriculture, Forestry and Horticulture

Edward Arnold and Co.—British Economic Grasses, Sydney Burr and Dorothy Turner. *Cambridge University Press.*—The Foundations of Agricultural Economics, Dr. J. A. Venn. *Country Life, Ltd.*—The Care and Repair of Ornamental Trees, A. D. C. Le Sueur. *McGraw-Hill Publishing Co., Ltd.*—Back to the Land for a Living, A. Durgée. *Herbert Jenkins, Ltd.*—Earnest Earth, Elsie Grey Turner. *Thomas Murby and Co.*—The Methods of Examining the Soil, Physical and Chemical, C. H. Wright. *John Murray.*—Trees and Shrubs hardy in the British Isles, W. J. Bean. *Oliver and Boyd, Ltd.*—Agriculture, the Science and Practice of British Farming, Prof. J. A. S. Watson and James A. More; Practical Animal Husbandry, W. C. Miller and Major E. D. S. Robertson. *Oxford University Press.*—'Meria Laricis': The Leaf Cast Disease of Larch, T. R. Peace and C. H. Holmes; Open Air Dairying, R. N. Dixey and M. Messer; The Culture and Marketing of Tea, C. R. Harler.

Anthropology and Archæology

Cambridge University Press.—Religious and Cosmic Beliefs of Central Polynesia, R. W. Williamson. *Chapman and Hall, Ltd.*—A Short History of Ancient Egypt, Arthur Weigall. *J. M. Dent and Sons, Ltd.*—The Archæology of Herod's Temple, Dr. F. J. Hollis. *George G. Harrap and Co., Ltd.*—Myths and Legends of the Bantu, Dr.

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Letters to the Editor

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Change of Magnetic Susceptibility of Platinum, Copper and Silver caused by Cold-Working

A FEW years ago¹ we reported the result of an investigation on this subject. In spite of the fact that many workers have repeated the investigation, this important problem has not yet been completely solved. It is well known that the susceptibility of non-magnetic [metals is greatly affected by the

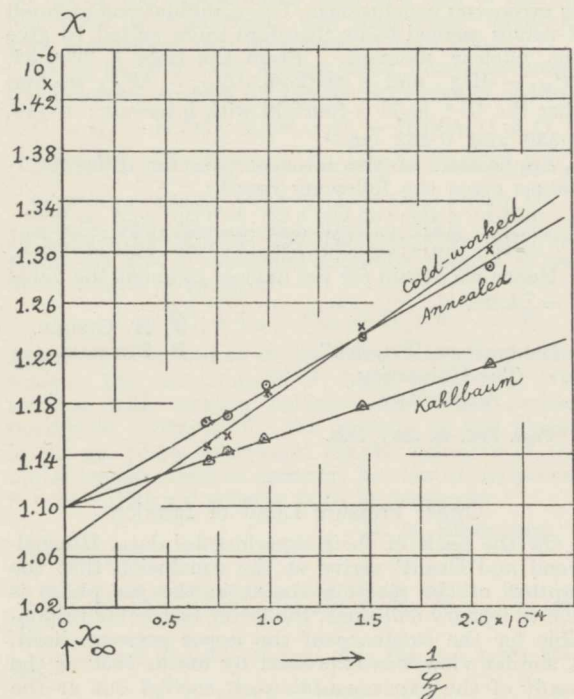


FIG. 1. Platinum. Density change by cold-working, from 21.5405 to 21.0408.

presence of a very small amount of ferromagnetic impurity, and that this disturbing effect can be eliminated by measuring the susceptibility in different magnetic fields and by extrapolating these values to an infinite field.

The cold-working was given to metals by means of a large press, the total maximum pressure amounting to 300 tons. The measurement of susceptibility was made by means of an improved Weiss's electromagnetic method. In general, the density of a metal diminishes by cold-working or residual internal stress. The result of measurement of the susceptibility for three annealed metals, platinum, copper and silver, is given below, the effect of ferromagnetic impurities being eliminated in the above way:—

Pt	Cu	Ag
$\chi = 1.100 \times 10^{-6}$,	-0.0848×10^{-6} ,	-0.185×10^{-6}

Figs. 1, 2, 3 show respectively χ -curves of these metals plotted against $1/H$ in the case of cold-worked

specimens and also the same specimens annealed in *vacuo*. It is seen that the value of $\chi_{H=\infty}$ of the cold-worked platinum is slightly less than that of the annealed metal, while the same value for copper and

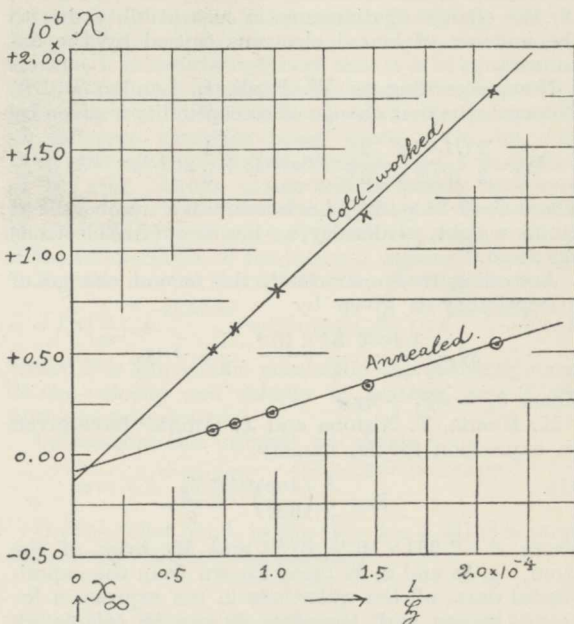


FIG. 2. Copper. Density change by cold-working, from 8.9521 to 8.66463.

silver is numerically greater in the case of cold-worked specimens than in the case of annealed specimens. The change of the diamagnetic susceptibility of

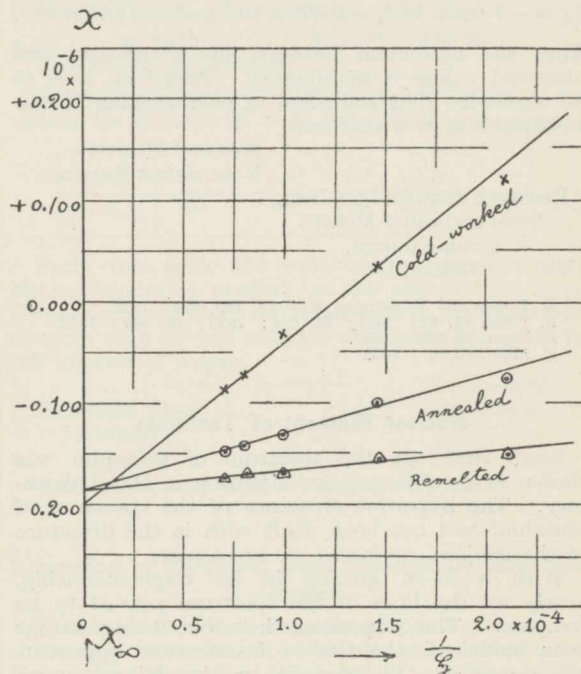


FIG. 3. Silver. Density change by cold-working, from 10.5631 to 10.4644.

copper and silver to a paramagnetic, is now shown to be the effect of impurity of iron, as already remarked by Kussmann and Sosmann.

Theoretically considered, the magnetic susceptibility is affected by the volume expansion caused by the internal stress in two different ways:—(1) the change of paramagnetic susceptibility due to the diminution of free electrons caused by the expansion; (2) the change of diamagnetic susceptibility due to the increase of bound electrons caused by the expansion.

Now, according to W. Pauli, L. Landau and L. Posener², the first change of susceptibility is given by

$$\delta\chi_1 = \frac{2CL^{1/3}}{3W^{1/3}} \left(-\frac{2}{3}\rho^{-5/3}\alpha^{1/3}\delta\rho + \frac{1}{3}\alpha^{-2/3}\rho^{-2/3}\delta\alpha \right),$$

where $C = 2.21 \times 10^{-14}$, L = Loschmidt's number, W = atomic weight, ρ = density, α = number of free electrons per atom.

According to Sommerfeld³, the second change of susceptibility is given by

$$\delta\chi_2 = \frac{3.1 \times 1.84 \times 10^{-5}}{W} \cdot \frac{1}{3} \alpha^{-2/3} \delta\alpha.$$

Hence $\delta\chi = \delta\chi_1 + \delta\chi_2$.

K. Honda, T. Nishina and T. Hirone⁴ have given an expression for $\delta\alpha$, namely,

$$\delta\alpha = \frac{A}{3} \left(\frac{4\pi\rho}{3M} \right)^{0.488} \frac{\delta\rho}{\rho},$$

where $A = 2.261 \times 10^{-12} Z^{0.513}$ and M = mass of the atom. ρ , $\delta\rho$ and α , $\delta\alpha$ being known from the experimental data, all the quantities in the expression for $\delta\chi$ are known and, therefore, $\delta\chi$ can be calculated. The results of this calculation for platinum, copper and silver are respectively,

$$\delta\chi = -0.023 \times 10^{-6}, -0.064 \times 10^{-6} \text{ and } -0.010 \times 10^{-6};$$

while those observed are

$$\delta\chi = -0.030 \times 10^{-6}, -0.078 \times 10^{-6} \text{ and } -0.011 \times 10^{-6}.$$

Thus the agreement between the theoretical and observed values is satisfactory. Therefore, it is to be concluded that the effect of cold-working on the susceptibility is a real one.

KOTARÔ HONDA.
YOSOMATSU SHIMIZU.

Research Institute for Iron,
Steel and other Metals,
Sendai, Japan.
June 21.

¹ K. Honda and Y. Shimizu, *NATURE*, 123, 990; 1930.
² *Z. Phys.*, 41, 99; 1927; 64, 629; 1930; 75, 809; 1932.
³ *Z. Phys.*, 78, 283; 1932.
⁴ *Z. Phys.*, 76, 80; 1932.

Nuclear Moment of Tantalum

SOME time ago the spectrum of tantalum was chosen as a subject of investigation in this Laboratory. The hyperfine structure of the spectrum of tantalum had not been dealt with in the literature of the subject, so far as we are aware.

With a 21-ft. grating in an Eagle-mounting, nearly all the lines of the spectrum proved to be complex. The dispersion, however, being so far from sufficient, the use of interference apparatus was necessary. We therefore used a Hilger quartz Lummer plate combined with the 21-ft. grating in a stigmatic mounting with a concave mirror, so that both instruments gave crossed spectra. As a light source we used a horizontal arc of 5 amp. between two rods of tantalum with a diameter of 2.5 mm.

and a pole distance of 1 mm. The arc burned in a current of air of 1.5 cm. pressure.

Mr. C. C. Kiess, of the Bureau of Standards, kindly sent us the preliminary list of terms of the arc spectrum, for which we are very much indebted to him. Grace and MacMillan¹ have recently reported their investigation of the hyperfine structure of tantalum, and they suggest for the nuclear moment the value $I = \frac{7}{2} h/2\pi$, without definite proof however. Some of our preliminary results lead to the same conclusion by a different way.

From the complexity of some of the lines, it is evident that the nuclear moment is rather large. In this case the combinations of terms with high J -values will give so many components, that one cannot expect to obtain complete resolution. Even in the case of lines of the 'flag' type, it was difficult to ascertain the number of components. Moreover, the application of the interval rule may lead in this case to erroneous conclusions. The combinations of small J -values seemed to us therefore more suited to give the nuclear moment. From the lines λ 3996.32, ${}^4P_{1/2} - {}^4P_{3/2}$, and λ 4692.06, ${}^6D_{1/2} - {}^4P_{3/2}$, we find that the ${}^4P_{3/2}$ level is fourfold with intervals: 0.418, 0.330 and 0.253 cm.⁻¹.

Application of the interval rule for different I -values gives the following result:

$I=5/2$:	0.418:4=0.105	0.330:3=0.110	0.253:2=0.127
$I=7/2$:	0.418:5=0.084	0.330:4=0.083	0.253:3=0.084
$I=9/2$:	0.418:6=0.070	0.330:5=0.066	0.253:4=0.063

Hence we obtain for the nuclear moment the value $I = \frac{7}{2} h/2\pi$.

Laboratory "Physica",
The University,
Amsterdam.

J. H. GISOLF.
P. ZEEMAN.

¹ *Phys. Rev.*, 44, 325; 1933.

Upper Pressure Limit of Ignition

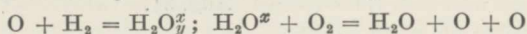
ON the basis of their experimental data, Hinshelwood and Grant¹ arrive at the conclusion that the rupture of the reaction chains in the gas phase is due to ternary collisions, the latter fact being responsible for the existence of the upper pressure limit. A similar view was expressed by me in 1930 as the result of the experimental work carried out at the Leningrad Physical-Technical Institute. As early as then, I believed that the existence of the upper limit could be interpreted only on the assumption of the deactivation process in the gas phase being due to ternary collisions. Indeed, the velocity of a chain reaction is $w = n_0/\beta - \delta$, where n_0 is the number of initial centres, β the probability of rupture, and δ that of branching. The condition for the existence of an upper limit is $\beta - \delta = 0$. If both breaking and branching of chains are due to double collisions, the values of β and δ will depend on the same order of the pressure, which leads to the absence of any upper pressure limit of ignition. For the existence of an upper limit, β should depend upon a higher order of pressure than δ . Thus, for example, if the branching of chains required double collisions, their rupture should be brought into relation with ternary collisions.

According to Hinshelwood and Grant, the relationship between the value of the upper limit and the temperature T is $p_2 = A_c \cdot e^{-E/RT}$. It may be recalled that the same equation can be found in our paper of 1930² on the oxidation of hydrogen and of

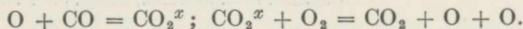
carbon monoxide. The expression has been partly derived from data obtained at Leningrad and partly from those published by Hinshelwood and Thompson in 1929. The activation energy for $H_2 + O_2$ was found to be 22,000 cal., which does not differ much from the corresponding value (25,000) given by Hinshelwood and Grant.

Hinshelwood and Grant further state that, contrary to theoretical considerations, which lead to the relationship $p_1 = B_e^{-E/RT}$, the value of the lower limit does not actually depend on temperature. I again refer to our paper, where the value of the lower limit was shown to vary with temperature according to the expression $ac^{-14,000/RT}$. It may be added that, within the limits of experimental error, 14,000 is half of 25,000. The problem of the relationship between the values of the upper and the lower limit will be discussed in another paper which will appear in the next issue of the *Phys. Z. Sovjetunion*. So far as the oxidation of hydrogen and of carbon monoxide is concerned, the theoretical equation $p_1 p_2 = \text{constant}$ will be shown to hold good.

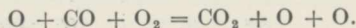
In our paper of 1930, already cited, I have advanced the following scheme for the development of chains:



In 1929³ a similar scheme was proposed for $CO + O_2$:



In a paper dated 1932, Hinshelwood, Thompson and Hadman⁴ give a somewhat modified scheme of the development of chains:



Attention is invited to the fact that, since, in the last scheme, the development of chains is brought into relation with ternary collisions, it would require quadruple collisions for the rupture of the chains in the gas phase to account for the existence of the upper pressure limit of ignition. In view of the above, it seems that my scheme is to be preferred.

N. N. SEMENOFF.

Leningrad.

¹ Hinshelwood and Grant, *Proc. Roy. Soc., A*, **141**, 29; 1933.
² Kopp, Kowalsky, Sagulin, Semenov, *Z. phys. Chem.*, **6 B**, 307; 1930.
³ Semenov, *Chem. Rev.*, **6**, 347; 1929.
⁴ Hinshelwood, Thompson, Hadman, *Proc. Roy. Soc., A*, **133**, 297; 1932.

I THINK it most useful that different lines of attack should be compared and contrasted, and am very pleased to associate myself with the publication of the above note. My indebtedness to the general ideas of Semenov has been acknowledged *passim*, though in the present instance I must remark that the upper limit of the hydrogen-oxygen reaction was discussed by Hinshelwood and Thompson in 1929¹, where the theory of some kind of gas phase deactivation was put forward and the fact that chain breaking must depend upon a higher power of concentration than chain starting was implicitly taken into account. The paper of Grant and Hinshelwood contained a quantitative re-investigation of the matter, yielding what seemed definite proof of the ternary collision hypothesis. With regard to the third point in the above letter, it should be remarked that Grant and Hinshelwood explained the influence of temperature on the lower limit, at least to their own satisfaction.

C. N. HINSHELWOOD.

¹ *Proc. Roy. Soc., A*, **122**, 610; 1929.

Internal Temperature of Stars

It may be of interest to notice that the investigation of the process of thermal transformation of light elements in stars¹ enables us to check the upper limit for the temperature of internal regions. In fact, so far as lithium is present, for example, on the star surface, it is natural to accept that it is in equilibrium with the lithium content in the internal regions of the star near the stellar nucleus, where the production of different elements takes place. On its way from the stellar nucleus through the hot regions of the star, lithium atoms will be partly destroyed by thermal collisions with hydrogen atoms ($Li^7 + H^1 \rightarrow 2He^4$) and will not reach the surface at all if the temperature of the internal regions is too high.

For the rate of the reaction in question we have:

$$\omega \sim \int \pi \left(\frac{h}{mv}\right)^2 \cdot e^{-2\pi Ze^2/hv} \cdot v \cdot N \cdot 4\pi v^2 \left(\frac{m}{2\pi kT}\right)^{3/2} \cdot e^{-mv^2/2kT} dv \quad (1)$$

where Z is the atomic number of the element, v and N the velocity and density of protons, and T the absolute temperature.

Calculating the integral we obtain:

$$\omega \sim N h^{5/2} \frac{(4\pi Ze^2)^{1/2}}{m^{3/2}(kT)^{3/2}} e^{-3/2(m/kT)^{1/2}} (2\pi Ze^2/h)^{3/2} \quad (1')$$

On the other hand, in the time $1/\omega$ a lithium atom will travel through the distance

$$l \sim \sqrt{D/\omega} \quad (2)$$

where the diffusion coefficient D is given by the expression:

$$D \sim (kT)^{1/2} / N^1 \sigma M^{1/2} m^{1/2} \quad (2')$$

Here N^1 is the total number of atoms in a cubic centimetre, σ the cross-section of collision, and M the atomic weight of the atoms in question.

Using (1') and (2'), we obtain from (2):

$$l \sim \frac{m^{5/2}(kT)^{7/2}}{\sqrt{N N^1 \sigma^{1/2} h^{5/2} M^{1/4} (4\pi Ze^2)^{1/2}}} e^{3/4(m/kT)^{1/2}} (2\pi Ze^2/h)^{3/2} \quad (3)$$

Accepting $N \sim N^1 \sim 10^{24}$ and $\sigma \sim 10^{-18}$ cm.², we obtain for lithium ($Z = 3$) the following numbers:

T (C°)	10^6	5×10^6	10^7	5×10^7	10^8
l (cm.)	10^{12}	10^6	10^4	10	1

From this table the conclusion is reached that either lithium is present on the star surface only occasionally or that no regions with temperatures of more than several millions of degrees can exist in the interior of a star.

G. GAMOW.
L. LANDAU.

Ksoochia Basa,
Khibini.
Aug. 10.

¹ Atkinson and Houtermans, *Z. Phys.*, **54**, 656; 1929.

Liberation of Electrons from Surfaces by Ions and Atoms

OLIPHANT and Moon¹ recently proposed a theory of electron emission at ion collisions, and succeeded in interpreting the data of Oliphant². They differentiate two kinds of liberation of electrons: an emission of electrons due only to the kinetic energy of the impinging ions, and an emission which results essentially from the neutralisation of the ions at the surface. On the basis of this theory one would expect to find an

appreciable difference in the electron emission of surfaces upon bombarding with neutral atoms and with ions. This difference ought to be distinctly noticeable at low velocities.

We have investigated the electron emission of metal surfaces on bombarding with hydrogen, helium, neon and argon ions of varying velocities and with helium, neon and argon atoms of corresponding velocities. The apparatus was designed to permit work with both ions and atoms, and the same surface was used in every run. Atoms driven at known velocities were generated by neutralisation in their respective gases; the number of atoms was determined by measuring the rate of neutralisation during each experiment. The investigation was carried out

their kinetic energy, and hence will depend closely on their velocities and will disappear with decreasing energy. As the liberation of electrons by ions, however, is due partly to the neutralisation effect, and as this effect certainly depends little on velocity, we have to expect that the emissions of electrons by ions should not completely disappear with decreasing energy but more or less tend to approach a constant value. This coincides with what we have observed.

Further, we find that at low velocities the ion with the higher ionisation potential has also the higher emission coefficient; whereas at high energy the emission coefficients of ions and atoms, though being of the same order of magnitude, seem to depend chiefly on the mass of the imparting particles.

Further details and a complete discussion of this investigation will appear shortly.

H. KALLMANN.
A. ROSTAGNI.

Kaiser Wilhelm-Institut für
physikalische Chemie und Elek-
trochemie, Berlin-Dahlem.

Aug. 31.

¹ Oliphant and Moon, *Proc. Roy. Soc., A*, 127, 388; 1930.

² Oliphant, *Proc. Roy. Soc., A*, 127, 373; 1930.

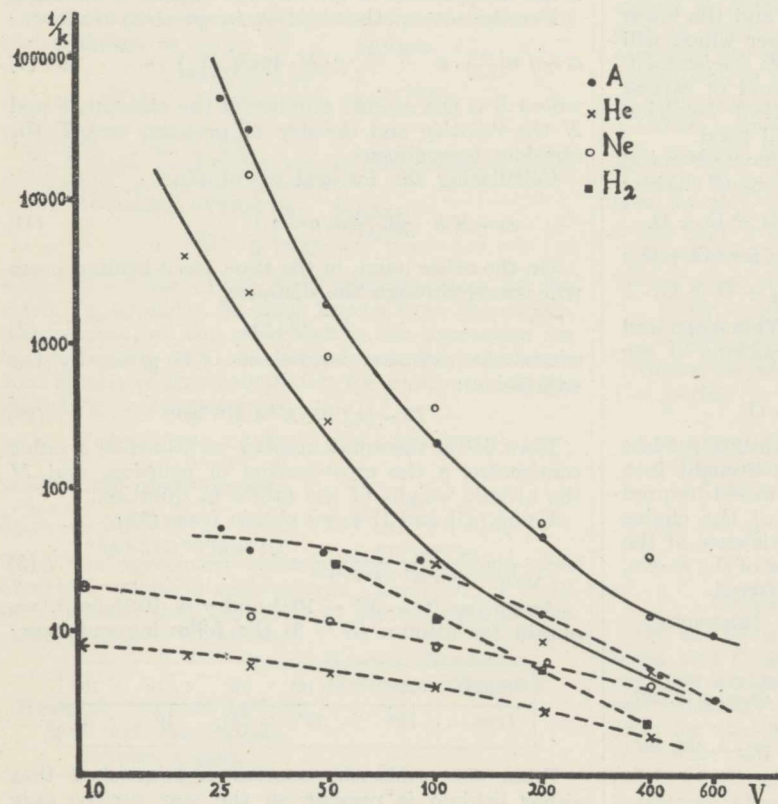


FIG. 1.

over an energy range of 6–600 volts. The production of atoms through neutralisation was found to be practically independent of the velocity down to about 6 volts. We were unable to detect a decrease in the number of neutralisations upon lowering the velocities.

The electron emission coefficients k are shown logarithmically in Fig. 1. The broken lines represent the emission coefficients of the ions, the solid lines those of the atoms. In the large energy regions the curves approach each other closely, but they diverge considerably for low energy values. While the emission coefficients of the atoms fall very rapidly with decreasing velocities, those of the ions, as has already been noted by other authors, approach a limiting value. This large difference between the emission coefficient of atoms and ions may be easily understood in the light of the above mentioned theory. The liberation of electrons by atoms can be due solely to

ment with those of Lewis², suggest that the necessary condition for the separation is that the hydrogen ion should itself be discharged at the electrode³; for this reason experiments were carried out in acid solution. Lead electrodes were used and the electrolyte was 5–10 per cent sulphuric acid. 10 litres of water were reduced to 1 c.c. in three stages with the following results :

Stage	Volume concentration per stage	Parts H ² per 1,000	Current density (amp. cm. ⁻²)	α
1	100	3.4	0.1	2.7
2	5.9	5.7	0.07–0.03	1.2
3	14	40.0	>0.1	3.8

The efficiency of the separation is measured by the value of the coefficient α in the assumed relationship, percentage loss H² = 1/ α percentage loss H¹.

To calculate α for the first stage it has been assumed that the water initially contained 1 part in 5,000 of the heavy isotope¹.

These results show that the separation occurs when the hydrogen ion itself is discharged. A possible explanation of the small degree of separation in the second stage is that H² does not show over-voltage.

C. H. COLLIE.

Clarendon Laboratory,
Oxford.
Sept. 13.

¹ Lewis, *J. Amer. Chem. Soc.*, 55, 1297; 1933.

² Lewis and Macdonald, *J. Chem. Phys.*, 1, 341; 1933.

³ "Gmelins Handbuch der anorganischen Chemie", 2 H., 209, 1927.

⁴ Bleakney and Gould, *Phys. Rev.*, 44; 1933.

A Second Whale Shark, *Rhineodon typus*, at the Galapagos Islands

In 1927, I recorded in *Science* the presence of the whale shark in the Galapagos Archipelago. This fish was seen on June 9, 1925, by Prof. W. K. Gregory and Mr. John Tee-Van of Dr. William Beebe's *Arcturus* Expedition. It was not captured but was seen under the stern of the ship and within 2-3 ft. of the surface. It soon sank, but not until it had been definitely recognised as a whale shark.

Included in my note were two other records of *Rhineodon typus* on the Pacific coast of South America; a specimen taken at Callao, Peru, in 1873, and another in the Bay of Panama in 1884. The two Galapagos specimens bring the total to four for this region.

In the spring of 1933, while Mr. Vincent Astor of New York was cruising among the Galapagos Islands, a specimen of this huge fish was seen and captured in Elizabeth Bay, Albemarle Island, on March 11. It was swimming at the surface but sounded immediately when harpooned. For an hour and a half it towed the launch, weighing about three tons, at varying speeds (at times as great as six knots) and mostly in circles. Then it came to the surface and swam about sluggishly for about two and a half hours before it succumbed to repeated harpoonings and a number of shots from a heavy rifle. The original harpoon was so firmly driven into its thick hide that it never came out, although it was by the harpoon line that the boat was towed about. Comment was made at the time that the fish offered no resistance and put up no such fight as one would expect from a shark of its size.

The weight of this specimen could not be definitely determined, but Mr. Astor estimated it at about three tons. This was based on the fact that to get it aboard the yacht it was necessary to use the two davits by which the three-ton launch is lifted aboard. This is probably an under- rather than an over-estimate.

This 23 ft. fish was a young specimen. The fish has been measured up to 45 ft. by Swinburne Ward in the Seychelles Islands, in the western Indian Ocean. H. M. Smith has estimated one at 60 ft. taken in a fish trap of that standard length in the Gulf of Siam. Several whale sharks have been taken in Florida waters and off Havana which measured 30-35 ft. 'over all'. A $\frac{1}{4}$ scale model of a 32-ft. specimen is on display in the Fish Hall of the American Museum of Natural History. The tail of the fish under consideration has been presented to the Museum by Mr. Astor and will probably be

mounted and put on display later. A number of photographs of this specimen were taken by Mr. Milton W. Holden. Copies of these have kindly been presented to our collection of such—the largest in the world.

For twenty years I have been recording occurrences of *Rhineodon* in various oceans, and I am pleased to add another to the list. For the data on which this note is based, I am under obligation to Mr. Astor, who has added to the records of the whale shark in all the oceans the sixty-seventh specimen.

E. W. GUDGER.

American Museum of Natural History,
77th Street, New York.
July 14.

Sickle-Fibres of the New Zealand Romney Lamb

SICKLE-FIBRES have recently been the subject of communications to NATURE by Prof. J. E. Duerden¹ and Dr. S. G. Barker². In a minute study of a fibre selected by Prof. Duerden as a typical sickle-fibre from a Blackface lamb, Dr. Barker found that along the sub-apical portion, between the sickle-shaped tip and the definitive fibre grown after birth, the area of cross-section was very little smaller, if at all, than that of the sickle region.

The New Zealand Romney is often accused of 'hairiness', that is, coarse medullation, but the breed as a whole is much less hairy than an avowedly hairy mountain type of sheep. I am not familiar with the Blackface birthcoat, but perhaps the coarseness of the sub-apical region of the representative fibre described by Dr. Barker is one expression of the hairiness of the breed. It is the purpose of this note to report that in the New Zealand Romney, though fibres with a coarser sub-apical region are plentiful, sickle-fibres abound in which the sickle-end is well medullated, while the sub-apical portion is free from medulla or very slightly medullated, and that such fibres are seen in the W.I.R.A. rotator to have every axis of a portion of the sickle-end greater than any axis whatever in the sub-apical region. This fact is of some theoretical interest to me, for I look upon this sub-apical thinning as one expression of the prenatal check, a phenomenon which appears to me³ not primitive, but specialised.

Now that Dr. Barker has told me about it, I detect within my thick sickle region the rotation of the axes of the cross-sectional ellipse. As a non-mathematician, I welcome Dr. Barker's treatment of this material. The hairs of mammals, growing only at the basal end, record the resultants of the changing forces at work in the follicle. These autographic records, pushed out in profusion from the skin of mammals, await the interpretation of any morphologist or physicist who may be able to decipher them. Casting my eye over a mob of sheep I have come to look upon each animal as an island universe, not of spheres, but of filaments, and from the mathematical study of these objects much illumination is to be expected.

F. W. DRY.

Massey Agricultural College,
Palmerston North,
New Zealand.
Aug. 7.

¹ NATURE, 130, 736, Nov. 12, 1932.

² NATURE, 131, 799, June 3, 1933.

³ *J. Text. Inst.*, 24, T.161; 1933.

Occurrence of *Craspedacusta sowerbii*, Lankester, in Monmouthshire

At the end of August one of my students, Mr. H. Jenkins, sent me some medusæ which he had found in a reservoir at the Bedwelly Pits Colliery, Tredegar, Monmouthshire. They proved on examination to belong to *Craspedacusta sowerbii*, Lankester. The medusæ were very numerous and ranged from quite small specimens to those measuring at least half an inch in diameter. The reservoir was originally constructed to feed the boilers of the colliery, and is divided into three compartments. The medusæ were found in the central compartment only. This is 80 yards long, from 4 to 14 yards wide, and from 2 to 8 feet deep.

The water entering the reservoir is drainage water from the surrounding mountain-sides, which enters by two main inlet streams. There are no outlets except the pipes to the boilers and an overflow in very wet weather. The reservoir has been stocked from time to time by the local angling society with fish (perch, tench, roach and rudd) and with freshwater snails and mussels. No traces of the medusa were found in the inlet streams or in the Bedwelly Park ponds and the River Howy in the neighbourhood. This occurrence seems to me to be sufficiently remarkable and interesting to place on record.

W. M. TATTERSALL.

University College,
Cardiff.

Spawning of Trout

THE remarks in NATURE of August 26, p. 325, on the spawning of non-migratory trout raise some interesting points. In the Wiltshire and Hampshire chalk streams, an occasional trout is caught in September, which by its appearance is almost ready for spawning, but on these rivers spawning extends right up to the New Year.

The statutory close season on the Avon begins on October 16, and there is much controversy amongst fishermen of experience with regard to the right date to stop fishing. It is quite usual for fishing to cease on September 30, and the reason given is almost always that the fish before spawning feed more readily and are too easily caught. A minority assert that the fish rise well in the first week in October, are in excellent condition, and that some of the older fish, which are better out of the water, are taken. It will be seen that the trend of opinion here is contrary to the suggestion that there is a pre-spawning period of abstinence from food, or alternatively the date of general spawning on these rivers is rather later than that suggested in the note in NATURE.

It is a matter of common experience that trout, which are shy risers, are often taken late in September on fancy flies, when they are not taking the natural fly, which argues an abnormal appetite at this period.

A. H. HALL.

Woodlands, Farnborough,
Hants. Sept. 5.

MR. HALL's letter indicates that the problems in the life-history of the brown trout referred to in the note in NATURE of August 26, p. 325, have an interest for anglers and owners of fisheries. It also shows that anglers themselves may assist with data that merit consideration. As Miall said many years

ago, "much information . . . can be extracted from anglers by those who speak their language" (L. C. Miall, "The Natural History of Aquatic Insects").

It is likely that there are differences in the length and time of the spawning season in different types of river environments, and that meteorological factors may also exert a significant influence. That evidence on these points should be made available by those in a position to observe the facts is very desirable.

The question whether the trout's normal feeding is discontinued or diminished as spawning time approaches is one that can only be finally answered by the methods of exact research.

THE WRITER OF THE NOTE.

Strawberry Root Rot in England

DURING the past five or six years I have been specially interested in strawberry 'black root' or 'root rot' in relation to its effect on the deterioration of strawberry plantations in America, especially in Ontario, Canada. In many localities in the United States of America and in Canada 'root rot' is a factor of great importance and is considered by many as being one of the fundamental causes of 'failure' in strawberry cultivation. So important is this trouble considered to be that it is now being critically studied in many laboratories in the United States of America and in Canada, among others at St. Catharines, Ontario, Canada, by Walker and Hildebrand under my direction.

Various fungi have been isolated from the root lesions, and at St. Catharines, Ontario, Walker¹ has obtained evidence that one of these, a *Ramularia* sp. is pathogenic. Strong and Strong², working in Michigan, have also shown that root rot (black root) may be caused by *Coniothyrium* sp. and by *Hainesia lythri*. Also Zeller³ in Oregon has demonstrated that *Rhizoctonia Solani* is the cause of a similar root rot condition in Oregon. What appears to be a similar disease has also been reported from Washington, Utah, New York, in the United States of America; and from Australia, Scotland and France.

The symptoms of 'root rot' are a general lack of vigour throughout the plant resulting in pronounced dwarfing of leaves and petioles, and a much reduced root system. The leaves take on a brownish tint and in time wilt and die. On the root, definite and conspicuous black lesions are apparent. In severe attacks the bulk of the lateral roots rot away, and the main roots show a profusion of black lesions.

Shortly after my arrival in England (on a year's visit under the 'exchange' system) I had occasion to visit a number of strawberry plantations in various parts in the south and west of England, and my interest was immediately roused by the fact that in many plantations numerous plants showed symptoms of disease similar to those associated with 'root rot' in Canada. On examining the roots of such plants I found that definite lesions were present on the larger roots and that root laterals were very scarce, a condition found in our 'root rot' disease in Canada. From general observations, therefore, it appeared as though there was present in England a root rot disease very similar in appearance to that found in Canada and the United States of America.

To ascertain if this was actually the case, isolations were made from lesioned roots and many fungi have been thus obtained. Of these, many were obviously

saprophytes, but others are being tested for pathogenicity. Already success has been obtained in that a species of *Coniothyrium*, so isolated, has consistently produced the disease in inoculation tests.

In a preliminary inoculation test strawberry plants grown in sterilised soil were inoculated with an infusion obtained by macerating affected roots taken from plants showing root rot symptoms. Within a month definite lesions appeared on the roots of the inoculated plants. Isolations were made from these lesions and further inoculations were carried out with the *pure cultures* of the organisms obtained. One of these, a species of *Coniothyrium*, has produced typical root rot lesions.

These observations and findings indicate that there is in Britain a strawberry root rot that is similar—though not necessarily identical in cause and effect—to that found in Canada and in the United States of America. Whether the trouble in this country is one disease or a congeries of several, and what is the rôle, under Kent and Sussex conditions, of the organisms associated with the root lesions are problems that are now being investigated at East Malling, as a result of these preliminary observations and experiments.

It would be most interesting and valuable to exchange ideas and even material with others already investigating these problems under different climatic conditions. The writer's address will be Plant Pathological Laboratory, East Malling Research Station, Kent.

G. H. BERKELEY

(Pathologist-in-Charge, Laboratory of
Plant Pathology, St. Catharines,
Ontario, Canada).

East Malling Research Station,
East Malling, Kent.

¹ Walker, A. R., Strawberry Root Rot. *Proc. Canad. Phytopath. Soc.*, 16-19, 1929.

² Strong, H. C., and Strong, M. C., Investigations on the Black Rot of Strawberries. *Phytopathology*, 21, 1041-60; 1931.

³ Zeller, S. M., A Strawberry Disease caused by *Rhizoctonia*. *Oregon Agric. Expt. Stn. Bull.*, 295, 1932.

Origin of Tektites

AUSTRALIAN observers have been most interested in the article by Dr. L. J. Spencer¹ on the origin of tektites, and more particularly on the origin of australites. In his reply to Mr. F. Chapman, Dr. Spencer² suggests that the term tektites is synonymous with "aerial fulgurites". That the australites are not aerial fulgurites is surely proved by their remarkably limited distribution. I am familiar with the slaggy siliceous material from the Henbury craters, but that bears no resemblance to the material nor the forms of the australites. It is nearly a century since Darwin first figured the australite and theorised as to its origin. Since then many theories have been put forward, but none has made so great an appeal for tentative acceptance as the meteoritic one. A positive test for nickel in australites would support this hypothesis.

CHAS. FENNER.

University of Adelaide,
July 24.

¹ NATURE, 131, 117, Jan. 28, 1933.

² *ibid.*, 131, 876, June 17, 1933.

THE term "aerial fulgurite" was suggested by, and has reference to, Mr. F. Chapman's theory of the origin of tektites. In addition to the slaggy siliceous material from the Henbury meteorite craters, small glassy bombs of silica-glass have more recently been found by Mr. R. Bedford. Some of these are figured in the *Mineralogical Magazine* (September, 1933, plate 18), and they show a certain resemblance in form, as well as in chemical composition, to australites.

On the same plate are figured minute spheres (0.01-0.05 mm. diam.) of nickel-iron isolated from the silica-glass of the meteorite craters at Wabar in Arabia, in some specimens of which they are present in vast numbers (two million per cubic centimetre). These evidently represent a rain or fine drizzle of condensed iron and nickel from the vaporisation of the meteorite.

Similar metallic spheres attracted by a magnet are also abundantly present in some specimens of Darwin glass from Tasmania, but they are less prominent in the Henbury silica-glass. In micro-sections of australites and of tektites from Indo-China a few black spots of similar dimensions and showing a metallic lustre by reflected light can usually be found if patiently searched for—but here they are rare.

The meteoritic theory of the origin of tektites is certainly one that appeals to the imagination, but in reality there is not a single fact that can be adduced in its favour—the evidence is entirely negative. From the data recently supplied by meteorite craters we have now at least some scraps of positive evidence. Some further evidence will perhaps be supplied by the air survey referred to in the *Times* of August 24, which is to be undertaken of the goldfields in the desert regions of Western Australia.

L. J. SPENCER.

British Museum (Natural History),
South Kensington, London, S.W.7.
Aug. 29.

Pigmies Making Fires

IN the review of Dr. P. Schebesta's book in NATURE of August 12, it is stated that "Although the pigmies use fires and are familiar with the use of the fire-drill among the surrounding peoples, they do not make fire themselves". This refers to the pigmies of the Ituri forest, but a couple of hundred miles to the south, the pigmies of the forested highlands west of Lake Kivu certainly do make fires. The Cockerell-Mackie-Ogilvie expedition obtained a moving picture of the whole operation, taken by Miss Alice Mackie. The sticks used, and the entire procedure, agree almost exactly with the methods of the Australian blacks, as shown on a film we obtained when in Australia. It is extremely interesting to see this identity of method among primitive peoples so far removed from one another. The pigmies of the Kivu district may be appreciably different in some respects from those of the Ituri (it has been claimed that the Kivu gorilla is separable from that of the country northward, but apparently on very slender grounds); a picture of their chief will be found in *Natural History*, 1932, p. 403.

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Sept. 10.

Research Items

An Unexplored Culture-Area in Yucatan. An account of discoveries of ruined cities discovered on a journey of archaeological exploration in Campeche has recently been published by Mr. Cyrus Longworth Lundell (*Proc. Amer. Phil. Soc.*, Philadelphia, 72, No. 3). The area, which was approached up the Champoton River, lies midway between the two great regions of Mayan civilisation, the Southern, which reached its apogee about A.D. 731, and the Northern, which centred at Chichen Itzá and attained its highest development in the two centuries after A.D. 1263. Important as a link between the two cultures, this country was archaeologically unexplored. The first site to be discovered was that of Calakmul, which is now being excavated under the direction of Dr. Silvanus P. Morley and has proved to be one of the most important cities discovered in recent years, ranking with Copan, Tikal and Palenque. The second site to be discovered was Nohoxna, a city built on a natural acropolis, twenty miles to the south-west of Calakmul, which appears to have been a great astronomical observatory, as well as one of the most important Mayan ceremonial centres. Nine stelæ, a "Mound of the Three Temples", a "castillo", exceptionally well preserved, and other remains were found. Eleven more sites of ruins were located, while information concerning several others was obtained. An impressive and unique monument along the south-western edge of the Calakmul lake, now silted up, is the "Wall of the Kings", a wall about ninety feet long, now more than twenty feet high, and about a metre thick. It is remarkable for five identical grotesque masks representing the jaguar, which appear at intervals on the lower part of the frieze, with a life-sized human figure on a projection above each of the masks. At each end of the wall is another life-sized human figure, apparently neither a priest nor ruler. Further information and observation indicated the vast field here open to archaeological exploration; but for the moment investigations are to be confined to Calakmul.

Training in the Acquisition of Skill. Mr. John W. Cox has recently published the results of some researches into the problem of formal training in the acquisition of skill (*Brit. J. Psych.*, 24, Part 1). That training in one skill, or some one branch of knowledge, automatically improves the ability to learn others has been an axiom for numbers of educators. Laboratory experiments for the most part have failed to support the view; nevertheless it persists. Mr. Cox contributes evidence of considerable importance. He experimented with adults and children, using simple industrial operations required in assembling, wiring and stripping the parts of an electric lamp-holder. His aim was to discover how far the effect of practice at any one of the operations would be transferred to the others, and then to investigate the effect of training as distinguished from practice. He found that skill, developed by the mere repetition of one manual operation, conferred little advantage on the performance of other operations afterwards undertaken; but that when such repetition was replaced by instruction, which aimed at helping the subject to grasp some of the general principles involved, then the skill, developed at no additional cost in time, tended to transfer to other operations, manifesting itself not only in superior ability but also in

a superior rate of progress. These results help to explain some of the conflicting views on the subject, and suggest that the custom of allowing beginners to pick up processes by unthinking repetition might with advantage be altered.

Researches on Plankton Production. Dr. E. Steemann Nielsen in his paper "Einleitende Untersuchungen über die Stoff-produktion des Planktons" (*Meddelelser fra Kommissionen for Danmarks Fiskeri- og Havundersøgelser. Serie Plankton. Bind 11, No. 4. 1933*) gives the results of some respiration and assimilation experiments with natural plankton, undertaken in the Marine Biological Laboratory at Fredrikshavn during the summer of 1931. Respiration was measured by the oxygen absorption in covered flasks, carbon dioxide assimilation by the oxygen production in uncovered flasks. The oxygen determination was carried out in a special Winkler flask. For drawing the water a Meyer's drawer was used, containing about 2½ litres. A series of 100 c.c. flasks with glass stoppers were filled as quickly as possible and one prepared for oxygen estimation, the others being sunk in different depths and made fast to a buoy. It was found that at 2 m. and at 0.2 m. the assimilation intensity was practically the same. A flask lighted from noon to sunset and one from sunrise to noon were together the same as one lighted for the whole twenty-four hours. The oxygen numbers vary a good deal according to the amount and quality of the plankton present. The compensation point, where the respiration and assimilation balance, is found to be about 7 m. This is much higher than if pure cultures of diatoms were used, the mixed plankton including both autotrophic and heterotrophic forms altering the results in many ways. Transparency of the water affects the assimilation at different depths, and this depends on the amount of plankton and detritus present.

Worm Infestation of Lambs. In a paper on worm infestation of lambs in the north of Scotland, prepared primarily for farmers, D. Robertson (*Scot. J. Agr.*, 16; 1933) gives a list of the different species of worms, found in the food canal (which harboured eleven species) and in the lungs (in which were two species of worms) of eight lambs suffering from parasitic gastritis, examined in September and October 1932. The author directs particular attention to the stomach worms, especially to the lesser stomach worm, *Ostertagia circumcincta*, and describes the symptoms of infestation, the life history and control. In two lambs examined, the fourth stomach contained respectively 16,930 and 18,110 of these worms. The second of these lambs was from a farm where overcrowding of the pasture had occurred during the last three years, and affords a good example of the danger of sheep farming on a large scale—260 acres of pasture were carrying about 375 ewes and their 500 lambs—with only a limited grazing area available. Four years of overcrowding has rendered the farm useless for sheep rearing as the ground has become heavily infested with worms. As a result of counts made of the worms present in lambs, it would appear that symptoms of disease due to the lesser stomach worm are unlikely to appear unless the number of worms present exceeds 8,000. Among other suggestions it is recommended that

lambs be moved on to clean grass as often as possible during the months (July to August) which are most suitable for development of the larvæ of the worm, so as to avoid reinfection.

A Fungus Parasite of Calabash. A serious wilt disease of calabash is caused by the fungus *Corticium centrifugum*, which has recently been studied in detail by T. Watanabe (*Bull. Utsunomiya Agric. Coll., Japan*, No. 3, "Studies on some characters of *Corticium centrifugum*", pp. 1-16, and "Vitality of *Corticium centrifugum*", pp. 17-28, July 1933). The fungus grows on a wide variety of nutrient media, but produces sclerotia most readily on soy bean agar and apricot agar. Asparagin agar and Richard's solution produced mycelial growth only. The fungus has an optimum temperature of 28° C. and attacks a wide variety of cultivated plants. Mycelia and sclerotia remained alive on the host plant and in the soil throughout the winter in Japan. The effect of many substances upon the fungus has been tried in the laboratory, and it appears easy to kill the parasite, but no field trials have as yet been undertaken.

Rock Joints and the Cleat of Coal. P. F. Kendall and H. Briggs have recently contributed to the long-discussed problem of the origin of joints and cleat (*Proc. Roy. Soc. Edin.*, 53 (ii) No. 13, 164-187; 1933). After clearly reviewing all the relevant evidence, they reach the following conclusions: (a) joints are formed not long after the bed is deposited; (b) the forces that cause jointing have acted throughout geological history; (c) the regular orientation of jointing implies an equally regular orientation for the forces concerned; (d) the species of stress most capable of producing joints is torsional; (e) alternating stress alone satisfies the data; (f) an alternating stress of small intensity of short frequency and lengthy duration is effective since it results in failure of the rock-mass by fatigue. Of these conclusions, (e) rules out the operation of continental drift or slowing down of the earth's rotation as effective causes. The only hypothesis competent to explain the facts is that originally suggested by Kendall to account for the cleat in coal, namely, that the responsible agent is the diurnal sweep of the earth-tide in an east to west direction round the earth. As a series of strata becomes consolidated by pressure, loss of moisture, etc., and gains in brittleness, it finds itself called upon to flex as a continuous elastic sheet under the alternating tidal torque. Eventually it fails through fatigue along the planes of maximum shear, and the joints then come into existence.

Variable Speed Cathode Ray Television. The *Journal of the Television Society* for December 1932 contains a description, by E. H. Traub, of a novel means of adapting the cathode ray oscillograph to television. In other systems the picture to be transmitted is scanned in horizontal or vertical strips by a spot of light moving along the strips with a constant velocity, and the picture current obtained from a photoelectric cell varies in intensity in accordance with the light and dark shades of the picture. At the receiving end the cathode ray or reproducing light beam moves across the screen with a constant velocity, but the intensity of the ray is varied in order to build up the picture. The new system, which is being developed practically by M. von Ardenne, makes use of a suggestion due to Thun that the intensity of the ray should be kept constant, but that its velocity across the screen should be varied. The result is that where

the ray is travelling slowly a light patch is obtained, and where the velocity is great a dark patch on the screen results. Owing to the high acceleration required in the scanning and reproducing beams to obtain satisfactory detail in the transmitted picture, this variable speed system can only be realised in practice by the use of cathode rays at both the transmitter and receiver. The article referred to states that satisfactory experiments have been carried out with this system over a land-line using a picture divided into 130 strips, and requiring a modulation frequency band of 25-200,000 cycles per second. A feature of the results obtained with this equipment is the remarkable brightness of the light spot at the receiver, so that the images can be observed on the screen in daylight or they can be projected.

Electrolytic Extraction of Slag from Iron and Carbon Steel. In view of the marked influence of slag in iron and steel upon the mechanical properties, and the difficulty of estimating the amount which is present with any real degree of accuracy, a paper on this subject read by R. Treje and Prof. C. Benedicks at the recent Sheffield meeting of the Iron and Steel Institute is of more than usual interest. The electrolysis is performed in a vessel which is divided by a diaphragm. The specimen is surrounded by a collodion bag, carried by a floating wooden ring, for the collection of the slag. The specimen itself forms the anode in a bromide solution containing sodium citrate. The cathode consists of a copper plate in copper sulphate solution. This arrangement, and choice of electrolytes, prevents any formation of oxygen gas on the anode—which would cause the liquid in the collodion bag to become acid and consequently to attack the slag—as well as avoiding the formation of hydrogen on the cathode and rendering the liquid there alkaline with the precipitation of hydroxides. The slag residue is collected by centrifuging after purification (? magnetically) from small quantities of metallic iron.

Bright-Line Stars. Since Secchi discovered, in 1866, that γ Cassiopeiæ and β Lyrae exhibit bright hydrogen lines in their spectra, 410 stars of early type have been discovered to possess bright hydrogen lines. Of these, 207 were detected at Mount Wilson, and Merrill and Miss Burwell have now collected the data together and published a complete catalogue of the 410 stars in the *Astrophysical Journal* (78, 87, September 1933). This Mount Wilson catalogue is accompanied by detailed notes on many of the spectra and by a comprehensive bibliography of the literature, both theoretical and observational, of the subject. The distribution of these objects in galactic latitude and longitude is especially interesting. The *Be* stars tend to group themselves about the galactic equator, and exhibit the interesting property of 'gregariousness', in that they tend to occur in marked groups. Merrill and Burwell point out that the Cepheids also possess the same property and that some of the favoured spots are common to both faint *Be* and Cepheid variable stars. While some of these groups may represent clusters, others may arise because both these classes of objects consist of very bright, but distant, stars which are most easily seen in those particular directions in which there is less obscuring matter in the Milky Way than the general amount. There are some regions which are deficient in *Be* stars; in these regions dark clouds may hide the more distant stars.

Spectroscopy in the Service of Industry*

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IN recent years, standard spectroscopic technique has been adopted by many industrial research laboratories and has proved a most valuable tool for the identification of the form and nature of impurities which have crept into the materials of ordinary technical processes. It frequently happens that when a manufacturing process goes wrong, there are very few outward and visible signs of the nature of the trouble. A lamp, for example, may have a slightly darkened glass bulb which is indicative of trouble to come. This darkening of the bulb may be due to minute traces, a thin film perhaps, of some deposit. It would be difficult, and sometimes impossible, to determine the nature of the deposit by ordinary chemical means. If the whole of it could be removed it might not weigh more than one ten thousandth of a gram. If the spectroscopist can remove the deposit, he is in an ideal position to give the manufacturer further clues as to the nature of his trouble. Technical processes are also frequently dependent on the addition of a small percentage of some foreign material to the bulk. In applied physics we may mention the quantity of thoria or silica in a tungsten filament; in metallurgy the percentage of nickel or tungsten in a steel.

The methods of excitation of the spectra are usually the standard ones of arc and spark; sometimes the technique of absorption spectra may be used. A very useful modification of the spark method consists in 'exploding' a wire and exciting the spectrum of the resultant vapour. This was developed by J. W. Ryde†, and is of great value in the electrical industry where the quality of wire is such an important factor. In order to facilitate the analysis of unknown spectra, Ryde and Jenkins have developed a special powder containing more than fifty elements. The quantities have been so adjusted that the *raies ultimes* of all of these elements appear when the powder is 'arced'. This method and the 'ratio-quantitative' method of Judd Lewis have been of great assistance in the routine applications of spectroscopy to industrial problems.

The applications of the general spectroscopic method are many, and it is impossible to refer to

more than a few here. The exploded wire method has been used with great success on small samples of various metallic wires such as tungsten, nickel and molybdenum. The transmission of ultra-violet light through glass is dependent, among other things, on the quantity of iron present. Preparation of a set of standards containing, say, 0.005–0.05 per cent of Fe_2O_3 , enables the quantity of iron in various glass-making sands to be estimated. The testing of steels before they leave the works is now carried out by means of the 'stelescope'. An upright rod of pure iron comes into contact with the test bar at some convenient point and the arc spectrum is observed. Bars which may have got into the consignment by mistake can in this way be readily identified. This is one of the first instances in which the spectroscope has been used in a routine manner by unskilled workers. Spectroscopic technique has been of great value in the development of hot cathode discharge tubes, such as the Osira lamp. In work of this kind new fundamental information is frequently obtained. With the Osira lamp, changes of colour and intensity can be followed as the pressure of mercury vapour increases: similar effects are to be observed with thallium rare gas spectra, as Krefft has shown.

The work of Hevesy and Laby on X-ray spectra is likely to be of use to industry, but has not yet received wide application. On a broad view, the applications of X-ray diffraction principles may be included in this summary. Provided the crystal structure is known, the X-ray crystallographer can indicate the form of any particular substance. For example, the state of the silica in refractory materials has a considerable effect on the expansion properties. The properties of drawn wires, in respect of crystal orientation, can readily be studied by this method. The cause of the red colour of selenium ruby glasses has been shown to be due to the actual composition of a cadmium selenide-cadmium sulphide solid solution. X-ray investigation of commercial glasses and of carbon blacks has also given useful information. Violet phosphorus has been shown to be fundamentally the same as red phosphorus, the only difference being one of crystal size. Very interesting work on the nature of oxide-coated cathodes has been correlated with their thermionic properties.

* Summary of a lecture given before Section A† (Technical Physics) of the British Association at Leicester on September 8.

† Research Laboratories of the General Electric Co. Ltd.

Natural Colouring Matters

IN opening a discussion on September 7 in Section B (Chemistry) of the British Association meeting at Leicester, which followed Prof. R. Robinson's address to the Section on "Natural Colouring Matters and their Analogues", Prof. R. Kuhn first reviewed the inter-relationship of the colouring matters of the carotene group. These substances are synthesised in plants and their molecules each contain forty carbon atoms. They undergo two types of degradation: in the animal body they produce vitamin A by hydrolytic fission, whilst in plants they are oxidised to carotenoids containing fewer carbon atoms. Among the natural oxidation products so formed are the pigments bixin, crocetin and azagrín. The other

decomposition products formed in these oxidations frequently possess characteristic colour, smell or taste. Similar oxidations of carotene have recently been carried out in the laboratory.

Another widely distributed class of natural dyes is the flavines. Two of these, ovoflavine from egg-albumin and lactoflavine from milk, have recently been obtained as yellow crystalline solids and are probably identical. These substances exhibit high vitamin B_2 activity, which persists after repeated crystallisation and even after acetylation and hydrolysis of the acetyl derivative. The flavines appear to be necessary items in the diet of mammals, like the carotenes. The general properties of the two classes

are, however, very different, as the flavines, unlike the carotenes, contain nitrogen, are soluble in water, resist the action of acids and oxidising agents and are labile to alkalis. The flavines can act as enzymes when combined with complex carriers and also as biological hydrogen acceptors.

Dr. R. P. Linstead described the phthalocyanines, a new class of synthetic colouring matters related to the naturally-derived porphyrins. These may be prepared from *ortho*-cyanobenzamide by the action of metals at 250° C., when they are formed as blue pigments containing metal (magnesium, iron, copper). Of these, only the magnesium compound is unstable to cold concentrated sulphuric acid, which removes the metal and yields the parent substance of the group, phthalocyanine. The metal-free, copper and magnesium pigments have the formulæ $(C_8H_4N_2)_4 H_2$, $(C_8H_4N_2)_4 Cu$ and $(C_8H_4N_2)_4 Mg \cdot 2H_2O$ respectively. They can be purified and the properties determined. They are remarkably stable except to acid oxidising agents; the copper compound may even be sublimed in nitrogen at 580° C.

Phthalocyanine differs from porphin, the structural basis of the porphyrins, in having four *isoindole* (benz-pyrrole) rings in place of four pyrroles. These are joined by nitrogen atoms ($-N=$) in place of the methine groups ($-CH=$) of the porphyrins and the whole forms a large, presumably planar, ring.

It was suggested by Dr. N. V. Sidgwick that the existence of the magnesium compound as a dihydrate is due to the inability of the metal to assume a planar 4-covalent state. If this is so, then beryllium, which can be neither planar 4-covalent nor hexavalent, should form no phthalocyanine pigment. Dr. K. F. Armstrong said that work which he has carried out in the porphyrin series gives somewhat analogous results in that certain zinc compounds appear to exist in a hydrated form.

In reply to a question by Prof. Freudenberg, Prof. R. Robinson stated his opinion that anthocyanins, flavines and substances of the tannin group are not capable of direct interconversion in the living plant but probably have a common natural precursor.

Early Bronze Age Site in the South-Eastern Fens

SPECIAL interest is attached to a report on the investigation of an Early Bronze Age settlement site on Plantation Farm, Shippea Hill, seven miles east-north-east of Ely, which appears in the *Antiquaries Journal*, 13, No. 3. It is the firstfruits of the activities of the Fenland Research Committee, which was founded in 1932 under the presidency of Prof. A. C. Seward with the object of studying the fens, as an area affording opportunities unrivalled in Britain for investigating post-glacial changes of environment in relation to man. An essential feature in the Committee's scheme of research was to secure the co-operation of specialists in the different sciences. How far this has been carried out may be seen in the report under consideration, in which Mr. Grahame Clark is responsible for the account of the site and the archaeological data, the investigation of the peat deposits and the analysis of the contained pollens has devolved on Dr. H. and Mrs. M. E. Godwin, Dr. W. A. Macfadyen reports on the foraminifera of the silts and clay, Dr. Wilfrid Jackson on animal remains and Mr. A. S. Kennard on the Mollusca.

The site, a sandhill, lies in flat black peat country reduced to agriculture only by the drainage of the seventeenth century. This country is traversed not only by modern dykes and communications, but also by the meandering 'roddons'—banks of light brown silt. Recent investigation has shown that these roddons are extinct watercourses, of which the silted up beds appear as banks, owing to the shrinkage of the adjacent peat. On Plantation Farm some of them are as much as 7 ft. 3 in. above the surface of the peat. The site under investigation was rather less than three feet above the present surface of the peat, but when the Little Ouse flowed along the course of the roddon, the upper peat, which now blankets all but the extreme top of the sandhills, must have covered the whole to a depth of 12–13 ft.

The results of the archaeological investigation may be summarised briefly as follows. The main occupation of the sandhill began in the Early Bronze Age, when a few inches of the upper peat had already formed. A numerically insignificant group of flint

instruments of Tardenoisian type, lying loose on the sand, pointed to an earlier occupation of brief duration, for which there is no indication of dating, apart from the fact that in boring through the lower peat a micro-flake was found at the base some 17½ ft. down, which, it may be suspected, belongs to the Tardenoisian group. This would point to a Late Boreal date. The significant pottery of the Early Bronze Age settlement is Beaker, some of it of the best period. An ill-fired buff-coloured ware is difficult to place, but cannot be long after the Beaker, as the occupation of the site was short. The stone implements form an assemblage conforming to what might be expected in the early phases of the bronze age. Scrapers are the predominant implement of the industry, and barbed and tanged arrow heads are the most usual. In the absence of the leaf arrow head, the polished axe and the narrow finely serrated flake, the industry differs essentially from that of neolithic camps.

The majority of the animal remains belong to domestic animals; wild animals are rare. The dog and horse are absent. Dr. Wilfrid Jackson reports that the animal remains closely resemble those from Woodhenge.

Borings were made with the object of ascertaining the history of the site. The basal deposit consists of sand. At one point the sand dips to form a flat-bottomed hollow, 17 ft. below the present surface of the ground. Here the deposits consist of a lower peat with a maximum thickness of 7½ ft., overlaid by a continuous deposit of buttery clay, and overlying this an upper peat, of which the greater part has wasted away.

The pollen analyses by Dr. and Mrs. Godwin point to the lower peat beds being of Late Boreal age, the most noteworthy feature being a marked predominance of alder. Oak, lime, hazel, elm and birch are present, but correspondingly low in amount. In the lowest deposit, however, there is a striking difference. *Pinus* is 68 per cent, alder falls to 22 per cent, and hazel is 42 per cent. In the upper peat, now reduced to 40 inches thick with the lower 24 inches only undisturbed by cultivation, there is a marked change.

All the same trees are present, but there is no marked predominance of the alder. The transition through the bed from an early dominance of oak to a dominance of alder suggests increasing wetness and an increasing prevalence of alder swamp. This is borne out by the pollen of herbaceous plants which are aquatic in character. At the bronze age occupation level *Tilia* has a maximum of 15, an unusually high figure for post-glacial peats; but the occurrence of a similar high percentage elsewhere in the Fens suggests that *Tilia* may afford a valuable chronological index for the Fens as a whole. The Early Bronze Age settlement thus falls in the sub-Boreal period.

Combining the evidence from the reports on the Foraminifera by Dr. Macfadyen and on the fresh-water Mollusca by Mr. A. S. Kennard, there would appear to have been certain changes in elevation in the history of the site. The point at which the Tardenoisian implement was found by boring in the

lower peat now lies at $-22\frac{1}{2}$ ft. O.D. Consequently at the date of that occupation the site must have been at a considerably higher elevation in relation to the sea than it is at present. A channel was at that time eroded through the peat and this was afterwards drowned by tidal estuarine silts of semi-marine character during a depression of the land in Atlantic times. A re-elevation took place, during which a channel, now 15 ft. below O.D., was eroded. This cuts into the marine silts and contains fresh-water Mollusca and the scales and bones of pike, pointing to a deep fresh-water river. The minor maximum of aquatic plants found to occur between two inches and nine inches from the base of the upper peat supplies a direct motive for the Early Bronze Age occupation in the shape of a dry 'island' situate in a shallow peat forming swamp. After a temporary recession, wet conditions set in again and ultimately caused the whole neighbourhood to be covered thickly with peat.

Annual Conference of the Association of Special Libraries and Information Bureaux

THE tenth Annual Conference of the Association of Special Libraries and Information Bureaux was held at Wills Hall, Bristol, on September 22-25. The report presented to the annual meeting indicated that despite the admirable work the Association is doing, there have been decreases during the year both in membership and in income. The Council is arranging for an intensive new membership campaign and the decision to hold the meeting at Bristol was part of a definite attempt to break new ground.

One of the features of the programme was a symposium on the Saturday morning devoted to the preparation and production of information bulletins, house journals and reports. The first paper presented to this symposium, by Mr. J. C. Stopani Stuart, of Messrs. Armstrong Whitworth and Co. Ltd., gave a broad survey of the general methods of organising a research or information bureau, but with this exception the papers might be regarded as falling into two groups: those dealing with the collection of material and those concerned with its reproduction. The first group of papers contained contributions from representatives of the British Non-Ferrous Metals Research Association, the British Cast Iron Research Association, the Mond Nickel Co. Ltd., Messrs. Edgar Allen and Co. Ltd. and the Metropolitan-Vickers Electrical Co. Ltd., and the detail with which the methods employed for the collection, selection and circulation of material used in the various abstract publications or information bulletins of these various organisations were described made the discussion of the utmost value to those engaged in such work. It is beyond question that the Association of Special Libraries and Information Bureaux provides in its annual Conference an unrivalled opportunity for comparing technique and discussing both general and special problems in this field.

The second group of papers, represented by those of Mr. G. T. Clarkson, of the Royal Aircraft Establishment, on the preparation and reproduction of illustrations for technical reports and of Mr. Norman Parley on facsimile processes with special reference to tabular work, were concerned with a special aspect of the same problem on which information is not so freely accessible as might be desired. Together these two papers contain much highly technical information

as well as comparisons of different methods of reproduction available for tables and for illustrations which should have a wide range of utility. The service would be the greater if the Association could follow up the papers by compiling and issuing standard figures for the comparative costs of reproduction by different processes, having regard to the number of copies, type of finish and degree of permanence required.

This symposium was followed by a discussion on abstracting methods with particular reference to efficiency and economy. The discussion arose from a paper by Prof. J. C. Philip in which he gave a succinct account of the recent policy of the Bureau of Chemical Abstracts and emphasised the importance of developing co-operation between the various bureaux concerned with abstracting if the available resources are to be adequate for the task. As an example, Prof. Philip referred to relations which are being developed with the Bureau of Animal Nutrition. Possibilities with regard to the utilisation of the same abstracts for different purposes by several bureaux or abstract journals are obvious to the independent observer, and the practical difficulties which exist are not sufficiently great to stand in the way of the advantages to be reaped by co-operation. Even within the fields of a single science such as chemistry, however, individual societies like the Society of Public Analysts persist in duplicating the work of the abstracting bureaux, apparently through the mistaken belief that an abstract should not be a pointer to the paper but provide in itself detail for experimental work. Only the really wealthy can afford to indulge in such a policy with any efficiency.

Apart from these discussions, the programme contained other specialist contributions such as that of Mr. S. W. Gibson on the classification of subject titles for engineering periodicals, in which he urged the advantage of some measure of control in the titles of papers in this field such as could be supplied by the use of an agreed guide. Mr. Evans Lewin indicated the need for co-ordination in bibliographical work within the British Empire, while Mr. B. M. Headicar described recent developments in equipment.

One of the most interesting sessions, however, was that at which Sir John Russell, under the title

"Books and Farmers", gave a delightful exposition of the possibilities of educational work in the agricultural community by the county library and others, and stressed the importance of good literature on English rural life as well as of popular expositions of the more technical or scientific side of agriculture.

At the final session, over which the Master of Sempill presided, Major H. Hemming delighted a large audience with his lantern lecture on "Air Survey Work: Its Various Aspects and Uses", in which he not only gave illustrations of results already achieved but also indicated the value of this new method of survey in development work generally, particularly when used in conjunction with other surveying methods. Major Hemming's lucid but restrained exposition prompted a discussion as to the means by which the results of such survey work could be made available on a national scale, and led to the suggestion that the Association of Special Libraries and Information Bureaux should itself investigate the possibility of establishing a clearing-house for this class of information.

University and Educational Intelligence

THE Hokkaido Imperial University of Japan announces in its calendar for 1933-34 that to the existing faculties of agriculture, medicine, technology and science will almost certainly be added in the near future a faculty of liberal arts. The calendar reproduces the imperial ordinances relating to the appointment of foreigners to professorial and other posts, but at present the only foreigners on the staff are five language instructors in the College preparatory school. There are 2,400 students on the roll of the University.

THE National Federation of Class Teachers held its thirty-ninth annual conference this year at Bristol. The delegates, to the number of two hundred, were accorded a civic welcome on September 29 by the Lord Mayor, the Vice-Chancellor of the University, and other representatives of phases of the life of the city. The subject of the presidential address, delivered by Miss A. M. Edwards, of Liverpool, was the advisability of raising the age limit of compulsory school attendance. In recapitulating the now familiar arguments in favour of this change, Miss Edwards touched on two crucial points: whether an additional year or more of compulsory schooling would result in (1) the schools turning out better recruits for industry and commerce, (2) promoting a taste and capacity for the right use of leisure. On the first point she protested against the "rash statements made at present by employers about the ineffectiveness of our present school system and what seems to them the failure of the schools to provide an education which will fit the child for industry," and directed attention to the lead given by governments in many other countries (the United States of America, Canada, South Africa, New Zealand, Norway, Switzerland and Hungary) where the school-leaving age has already been raised to fifteen years or higher, with the result, it is assumed, that England will be at a hopeless disadvantage in international competition unless she soon does likewise. Mention was made, with qualified approval, of a suggestion by Lord Eustace Percy that the raising of the age should be in stages, one term per year during 1935, 1936 and 1937.

Calendar of Nature Topics

Levanter

A characteristic type of pressure distribution in winter and spring shows an anticyclone over central Europe and a barometric depression over the south-western Mediterranean, while a strong squally north-east wind, known as the 'levanter', blows along the east coast of Spain. The levanter occurs most frequently in October-December and again in February-May, and often persists for two or three days. In the funnel-like western extremity of the Mediterranean the force of the wind is concentrated, and it blows through the Straits of Gibraltar as a very powerful east wind. The Rock of Gibraltar, standing in the path of this wind, causes remarkable eddies on its lee side. In summer the levanter is less frequent and is rarely strong.

English Pheasants

A hundred years ago, the English sportsman following pheasant shooting heralded the coming of October as a great event, though 'walking-up' was practically the only method followed, for his single-barrelled muzzle-loader limited his shots to too lengthy periods for much covert shooting. The first authentic records of the pheasant (*Phasianus colchicus*) in Britain seem to be in the eleventh century, though it was said to have been brought over by the Romans. As a result of game-keeping, the bird has increased to large numbers, and it has been estimated that since the Game Act of 1831, pheasants have been increased more than one thousand per cent in Great Britain. More than 3,000 pheasants have been shot in a day on certain estates, with the record for Great Britain believed to be 3,937 at Beaconsfield, Buckinghamshire (Hugh Gladstone). During recent years, the appearance of the melanistic-mutant sport, a very dark form, of the pheasant (*Phasianus tenebrosus*) created much interest. J. C. Hunting (*Field*, September 10, 1932) describes two strains of the mutant, in one of which the chicks are black, black and white or dark brown with white patches, the adult cocks having very dark green plumage and the hens mottled dark brown and russet with an irregular barring of light buff; and the second with the chicks unevenly marked black and white with black predominating, and the adult cock mostly very dark metallic green and black, the hen being a mixture of brown and black, and many feathers of her head and breast edged with dark metallic green.

Asia Minor is the home of the common English pheasant, but it has long been encouraged and transported from its original habitat, possibly the Athenians being the first to do so. The first protection laws in England were in the reign of Henry VII, when it was made an offence to take a pheasant, and in the time of Henry VIII the privilege of buying and selling the birds was confined to the royal household, with a year's imprisonment as the penalty for stealing the eggs. An Act of James I provided, for the first time, a close season for the birds.

Breeding of Great Grey Seals

An Act of Parliament of 1914 protected all grey seals (*Halichoerus grypus*) in Great Britain between October 1 and November 15, because at that time the species brings forth its helpless young on bare islands and rocks, or in the caves of the roughest coasts, chiefly on the west coast of Scotland, Ireland

and parts of the west of England, as Grassholme and Anglesey. A private Bill was passed in 1932 to protect the species from September 1 to December 31, excepting under an order of the Ministry of Agriculture and Fisheries, and this should be a great advantage, for though preying on salmon, the grey seal is probably beneficial in destroying vast numbers of dog-fish (*Naturalist*, June 1932). The grey seal probably also feeds largely on cuttlefish, and as its marine food is largely cod, the voracity of which among the fry of marketable fish is notorious, it does no damage to salmon fisheries (*Field*, April 2, 1932).

As a breeding species, the grey seal seems confined to the North Atlantic, chiefly the British Isles, Iceland, Scandinavia and occasionally Greenland and off Nova Scotia and Labrador. In the Shetland Islands and the Orkneys, the young are produced from September to November, but in Norway often not until February. Seal-hunting in Scotland used to take heavy toll of the species at breeding time, and Selby (*Ann. and Mag. Nat. Hist.*, Feb. 1841) records one killed on the Farn Islands weighing upwards of 47 stone. The grey seal is probably the commonest seal on the west coast of the British Isles, and has frequently been confused with the common seal (T. J. Moore, "Report on Pinnipedia and Cetacea of Liverpool District", *Proc. Liverpool Biol. Soc.*, 3, 263; 1889). A great deal has still to be noted on the feeding habits of the species, for though it was stated in the House of Lords during discussion of the Bill of 1932 that the grey seal eats 20 lb. of fish a day, there is little evidence. The cheek-teeth take the form of pointed spikes without cusps, as in Weddell's seal (*Leptonychotes weddelli*) which feeds largely on cuttlefish and Crustacea as well as fish. In old age the seals would probably subsist largely on seaweed.

Ospreys in Autumn

Although ospreys (*Pandion haliaëtus*) have not bred in the British Isles for nearly twenty years—the last pair are believed to have nested on Cameron's Island, Loch Arkaly, Inverness-shire—many immature specimens visit the east and south-east of England on their autumn passage from Scandinavia with a degree of regularity that is not always realised. Quite a large passage occurred in September and October 1930 (*British Birds*, 24, 5–11) when specimens occurred at Loch Lunart, Argyll; Grantown; Yarmouth; Hickling Broad, Harleston, Hornsea Mere and Rockland, Norfolk; Lowestoft; Surrey; Lewes, Sussex; Hertfordshire and Rutland. A number of the birds were needlessly shot. On July 1–19 of the past summer, a specimen frequented Gunton Greatwater, Norfolk (*British Birds*, September 1933), where also a specimen was watched in the 1930 passage. In 1927, 1928 and 1932, specimens were fishing for herling on the Lune, North Lancashire.

Sufficient protection in suitable Scottish localities should induce the osprey to nest again, but the release of two specimens at Lochiel by C. W. Knight, in 1930, was unsuccessful owing to the late period of the year, probably due to the small trout being at the bottom of the lake; they moved away and possibly were shot. In former times, ospreys nested on the Lake of Menteith, Loch Assynt, Loch Lomond, Loch Tay and Loch-an-Eilan. The last ospreys in Perthshire nested on Loch Ordie in the spring of 1887 (Knight, *Discovery*, 11, 122, Feb. 1930).

In parts of the north Baltic countries of Europe, and North America, the osprey is still abundant, and

at Gardiner's Island, off Montauk Point, Long Island, New York, which is an osprey sanctuary, the species also nests on rocks, in fields, and even on the seaweed on the beach as well as the typical site in trees. Records of nesting in Ireland seem obscure and the species is more accidental in its visits than to England.

Societies and Academies

GENEVA

Society of Physics and Natural History, July 6. E. FRIEDHEIM, B. SUSZ and J. BAER: The energy of activation and the temperature coefficient of a biological reaction. The respiration of the larvæ of *Diphyllobothrium latum*. The considerable range of temperature over which these larvæ live has led the authors to make a kinetic study with this parasite. The trend of the oxygen absorption curves is identical with that obtained in the case of a heterogeneous catalysis. E. JOUKOWSKY: On the frequent presence of pyrites crystals in the diatoms of a lake chalk: their probable bacterial origin. The author has found in a lake chalk diatoms containing pyrites in several forms. The iron arises from material dissolved or in suspension in the water. This hypothesis is one which it is possible to control by experiment. G. TIERY: Two theorems on ionisation in the Cepheids. The two theorems are based on the formula of the degree of ionisation. They show that the phase of maximum ionisation (the youngest spectrum) occurs after that of the maximum temperature and before that of the light maximum. M. GYSIN: Petrographical researches in the Haut-Katanga. (5). The formations of the system of Muva. This system includes the whole of the formations previous to the base conglomerate of Roan. The author distinguishes twelve principal types of rocks. G. GUTZEIT, M. GYSIN and R. GALOPIN: An attempt at the indirect chemical determination of the minerals in a polished surface by the drop test. A. WEINSTEIN: The theory of liquid jets taking capillarity into account. F. CHODAT and M. JUNQUERA: The endocellular hydrogen donors of yeast and their variation as a function of the age of the cultures. The authors give a report of their researches on the variation of the endocellular hydrogen donors of yeast with increasing age of the cultures. They add certain observations on the specific rôle of various buffer systems. L. REVERDIN: The presence of a wedge in an undescribed specimen from the older lacustral Neolithic. The author exhibits a specimen arising from the lower level of the neolithic remains of Port-Conty (Neuchâtel). It is composed of a fragment of hollow stag's horn, fitted with a wooden handle. Microscopic examination shows that this handle has been perforated by a wedge of a different kind of wood. The complete instrument might be either a club or the end of a hatchet handle, the fragment of horn acting as a sort of grip. G. GUTZEIT, R. MONNIER and R. BACHOUKOWA-BRUN: A new azo reagent for the magnesium cation, *p*-acetylaminophenyl-5-azoxyquinoline.

ROME

Royal National Academy of the Lincei, May 21. F. SEVERI: The theory of the correspondences to valency on an algebraic surface (2): in the invariant sense. U. CISOTTI: Quotients of vectors and monogenic vectors. G. LORIA: Considerations and notes concerning the history of mathematics. E. ALMANSI:

Deformations of elastic strips (6). MARIA CARETTI: Lines of maximum slope of Green's function. A. DEL CHIARO: Observations on Schwarz's smoothing procedure. C. FOUSIANIS: Roots of algebraic equations. R. LUIS GOMES: Linear operators: Further remarks. M. MANARINI: The divergence of plurivectors in the spaces S_n . C. MIRANDA: Summation by diagonals of Fourier's double series. A. TONOLO: Integration of the Maxwell-Hertz equations in uniaxial crystalline media. G. BARBA: Some observations on the nuclei of Andreoli and of Evans. M. LELLI: Similar and homotetic wells. L. GIALANELLA: Calculation of the orbital elements of a spectroscopic double star. G. AGAMENNONE: Diurnal-nocturnal periodicity of earthquakes. D. BOCCIARELLI: Radioactivity of potassium. In agreement with earlier measurements of the magnetic deflection, absorption measurements show that the radiation of potassium comprises: a relatively soft β component ($\sim 0.83c$), constituting about 60 per cent of the total intensity; a harder β component ($\sim 0.93c$), forming almost the whole of the remaining intensity; a very hard γ component, equal to about 1.08 per cent of the total radiation. G. PICCARDI: New bands in the spectrum of vanadium monoxide. As with the spectra of many other monoxides, the use of an excessively high temperature involves the disappearance of groups of bands situated among the lower wave-lengths. A. ROSSI: The crystalline structure of LaSn_3 and LaPb_3 . For LaSn_3 , the side of the unit cell has the value $a_0 = 4.77n \text{ \AA}$, n being a whole number; the calculated density is 7.516, but actual measurement gives lower values, owing to the presence of small cavities formed during crystallisation. For LaPb_3 , $a_0 = 4.893n \text{ \AA}$, and the calculated density is 10.71. In both cases, n is probably 1. CARLA REINA: Contribution to the study of the Paleogenic in the Island of Rhodes. G. CIACCIO: Influence of the zones of the iris on the regenerative capacity of the crystalline in adult tritons. T. PERRI: Behaviour of the primary optical vesicle of amphibia *in vitro* (2). V. SANGIRARDI: Modifications in the lipid content of the central nervous system in the convulsive state. LUISA POZZI: Supposed activators of proteolysis in tumours. Experiments on the cancerous tissue of the rat (Ehrlich strain) fail to indicate that it contains any principle having an activating influence on the catheptic proteases of normal organs.

SYDNEY

Linnean Society of New South Wales, June 28. H. M. R. RUPP: New South Wales and Queensland orchids. Investigations into the character of several forms allied to *Dendrobium speciosum* and *D. Kingianum* are discussed, and illustrated by diagrams of labella. A further contribution is made towards our knowledge of *Cryptanthemis Slateri*, Rupp, from Bullahdelah, a few flowers having been found in 1932 at a less advanced stage than those of the original 1931 discovery. Certain modifications of the original description are indicated. W. J. DAKIN and A. COLEFAX: Marine plankton of the coastal waters of New South Wales (1). The chief aims of the investigation are to discover (1) the seasonal variations in the plankton both qualitatively and quantitatively, (2) the relation of plankton changes to the physical environment, and (3) the eggs and larvæ of the food fishes of New South Wales waters and the conditions under which they are

spawned and hatched. The results to date show that the plankton at the station chosen is more or less free from littoral forms and is a complex of oceanic and neritic species. A distinct periodicity has been visible in connexion with most of the important constituents of the animal plankton. The zooplankton presents a maximum in the summer and another in the autumn. This first long-period study of the plankton conditions in Australian seas has, up to date, provided material of considerable interest from the point of view of geographical distribution and has indicated the occurrence of a regular and definite seasonal change in the plankton of these seas.

Royal Society of New South Wales, July 5. ALICE J. CHALMERS and FRANCIS LIONS. Binuclear isomerism of diphenyl type (2). Attempts to prepare 3-*o*-bromophenyl-4:7-dichloro indole-2-carboxylic acid, which should be resolvable, proved abortive, although 3-phenyl-4:7-dichloroindole-2-carboxylic acid and 3-*o*-bromophenyl indole-2-carboxylic acid were readily obtained. 1-*o*-bromophenyl- β -naphthazole-2-carboxylic acid was also prepared but could not be resolved owing to its weakly acid character. A. E. BRADFIELD, A. R. PENFOLD, and J. L. SIMONSEN: Zierone. The previously assigned formula of $\text{C}_{13}\text{H}_{20}\text{O}$ is corrected to $\text{C}_{15}\text{H}_{22}\text{O}$. It is thus shown to be a sesquiterpene ketone isomeric with eremophilone (*J. Chem. Soc.*, 2744; 1932; *J. Proc. Roy. Soc. N.S.W.*, 66, 420; 1932). This highly lævo-rotary sesquiterpene ketone is considered to be tricyclic with one ethylenic linkage. It yields a well-defined semicarbazone, melting point 182° , and a 2:4-dinitrophenylhydrazone, melting point $95^\circ\text{--}97^\circ$. T. H. HARRISON: Brown rot of fruits and associated diseases of deciduous fruit trees. Field and laboratory experience of all organisms concerned led the author to conclude that there are three valid species represented: (1) *Sclerotinia fructigena*, Ader. and Ruh., (2) *S. laxa*, Ader. and Ruh., and (3) *S. fructicola* (Wint.), Rehm. The known geographic range of each is given. Evidence is submitted to show that the apricot *Monilia* of Europe is co-specific with the fungus hitherto known as *S. cinera*, Bon. Schröt. *S. laxa*, Ader. and Ruh. is the correct combination for this fungus. Pending general revision of the genus *Sclerotinia* the author prefers to retain the brown rot fungi in that genus.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, 19, 581-640, June 15, 1933). JOSEPH C. BOYCE, DONALD H. MENZEL and CECILIA H. PAYNE: Forbidden lines in astrophysical sources. A survey of available data on the subject. Among the spectra of light elements identified are Ne III, Ne IV and F III. HARLOW SHAPLEY: Luminosity distribution and average density of matter in twenty-five groups of galaxies. The approximate mean density of matter in space is 5×10^{-70} galaxies per cubic centimetre, except where galaxies are nearly in contact, where it may be ten times as great. JOEL STEBBINS and C. M. HUFFER: Absorption and space reddening in the galaxy from the colours of *B*-stars. Observations with a photoelectric cell of *B*-stars, correlated with the work of other observers, indicate that our galactic system is filled near its median plane with a layer of dark matter, which reddens stars at a sufficient distance and obscures everything behind it. Globular clusters in the direction of the nucleus of our galaxy are probably all on this side of the galactic centre. The

dark matter of our galaxy may be greater in total mass than that which is luminous. FRANK H. SMITH: Preliminary studies of chromosome rings in *Brodiaea lactea*. 21-24 pairs of chromosomes are present and ring or chain associations of four small, four large or six chromosomes have been observed. CLYDE E. KEELER: Absence of the corpus callosum as a Mendelising character in the house mouse. The investigation is laborious because diagnosis of the condition necessitates sacrificing the animal, but none of the matings gives results which suggest other than that the character is a single Mendelian recessive, apparently not detrimental to the individual. P. A. SMITH: The topology of involutions. EDWIN H. HALL: On supraconductivity and the Hall effect. Experimental work at low temperature suggests that, in supraconducting lead, there is very little or no tendency for an electric current to move sideways through the metal (Hall effect). The validity of the work is questioned on the grounds that it assumes full penetration of a supraconducting metal by a magnetic flux—which is regarded as unlikely—and that the current observed in a supraconducting metal may be an aggregate of microscopic electric whirls within the metal and not a circumferential persistent current. GEORGE W. PUCHER and HUBERT BRADFORD VICKERY: The katabolism of the non-volatile organic acids of tobacco leaves during curing. Large losses (up to 100 per cent) of oxalic acid occur during dehydration with alcohol and usual modes of esterification; it should be extracted with ether. Oxalic, malic and monobasic acid content of leaves are little changed by curing; citric acid increases enormously and polybasic acids decrease very rapidly. HENRY BORSOOK and GEOFFREY KEIGHLEY: The energy of urea synthesis. Using a modification of the Warburg technique, increased oxygen consumption accompanied synthesis of urea from ammonium bicarbonate in Ringer's solution. GREGORY PINCUS and PRISCILLA WHITE: On the inheritance of diabetes mellitus. Treating the limited data available statistically and making certain assumptions, they give results in fair agreement with the supposition that the capacity for developing diabetes is inherited as a Mendelian recessive. A. E. NAVEZ: Growth-promoting substance and illumination. Apical parts of *Lupinus albus* seedlings grown in the light appears to give twice as much growth-promoting substance (auxin) as seedlings grown in the dark. T. CUNLIFFE BARNES and T. L. JAHN: The effect of ice and steam water on *Euglena*. The average increase in this organism in 10-16 days was 32 per cent in condensed steam water and 105 per cent in ice water.

Forthcoming Events

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

Monday, Oct. 9

UNIVERSITY OF LONDON, at 5.30—(at King's College).
—Prof. Henri Baulig: "The Changing Sea Level"
(succeeding lectures on Oct. 11, 12 and 16).*

Tuesday, Oct. 10

ILLUMINATING ENGINEERING SOCIETY, at 6.30—(at E.L.M.A., Lighting Service Bureau, 2 Savoy Hill, W.C.2).—C. W. Sulley: Presidential address.

ROYAL SOCIETY OF MEDICINE (Section of Therapeutics and Pharmacology), at 5.—Dr. J. H. Burn: "A Pharmacological Approach to the Cause of Asthma" (Presidential address).

Official Publications Received

GREAT BRITAIN AND IRELAND

The Royal Technical College, Glasgow. Calendar for the One Hundred and Thirty-eighth Session, 1933-1934. Pp. 460+xxiv. (Glasgow.)

Transactions of the Royal Society of Edinburgh. Vol. 57, Part 3, No. 27: Stratigraphical Observations in the Stor Fjord Region of Spitsbergen. By Dr. G. W. Tyrrell; with an Appendix on the Mesozoic Fossils from Spitsbergen collected by Dr. G. W. Tyrrell, by Dr. J. Wei. Pp. 675-697+1 plate. 3s. 6d. Vol. 57, Part 3, No. 28: The Structure of the Foot in certain Mosses and in *Anthoeceros lewisii*. By Nellie M. Blaikley. Pp. 699-709. 1s. 6d. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

Annual Report of the Director of the Meteorological Office presented by the Meteorological Committee to the Air Council for the Year ended March 31, 1933. (M.O. 358.) Pp. 55. (London: H.M. Stationery Office.) 1s. net.

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1486 (I.C.E. 841 and 841a): Oil Cooling for Aircraft. By B. C. Carter. Pp. 58+33 plates. 3s. 6d. net. No. 1528 (T. 3304a): Determination of the Stresses in Braced Frameworks. By L. Chitty. Pp. 36. 1s. 9d. net. No. 1538 (Strut. 129): Effect of Ribs on Stresses in Spars. By D. Williams and Dr. H. Roxbee Cox. Pp. 12+3 plates. 1s. net. No. 1542 (N. 81): Silencing Aircraft. By Dr. A. H. Davis. Pp. 10+2 plates. 9d. net. (London: H.M. Stationery Office.)

The Journal of the Institution of Electrical Engineers. Edited by P. F. Rowell. Vol. 73. No. 441, September. Pp. 213-320+xxvi. (London: E. and F. N. Spon, Ltd.) 10s. 6d.

The Detection and Determination of Small Amounts of Inorganic Substances by Colorimetric Methods. By N. Strafford. Pp. 36. (London: Institute of Chemistry.)

Proceedings of the Linnean Society of London, Session 1932-33. Part 3, including Presidential Address by Prof. F. E. Weiss: Variegated Foliage. Pp. 105-150. (London: Linnean Society.) 1s. 6d.

The North Staffordshire Field Club. Transactions and Annual Report, 1932-33. Edited by the Rev. E. Deacon. (Vol. 67.) Pp. 155+A75-A106. (Stafford.) 7s. 6d.

OTHER COUNTRIES

Journal of the Federated Malay States Museums. Vol. 17, Part 2, July. Pp. 223-417. (Kuala Lumpur.)

Proceedings of the American Philosophical Society. Vol. 72, No. 4. Pp. 215-283. (Philadelphia.)

Field Museum of Natural History. Anthropology Leaflet 31: Prehistoric Man: Hall of the Stone Age of the Old World. By Henry Field. Pp. 44+8 plates. (Chicago.) 25 cents.

University of Washington Publications in Anthropology. Vol. 5: The Sanpilo and Nespelem; Salishan Peoples of Northeastern Washington. By Verne F. Ray. Pp. 237. (Seattle, Wash.: University of Washington Press.) 2 dollars.

Zoologica: Scientific Contributions of the New York Zoological Society. Vol. 16, Nos. 1, 2 and 3: Deep-Sea Fishes of the Bermuda Oceanographic Expeditions. No. 1: Introduction; No. 2: Family Alepocephalidae; No. 3: Family Argentinidae. By William Beebe. Pp. 147. (New York City.)

Annals of the Royal Botanic Garden, Calcutta. Vol. 13: Asiatic Palms—Coryphaea. Posthumous Work by Dr. Odoardo Beccari. Revised and edited by Prof. Ugo line Martelli. Pp. vii+356. 50 rupees; 75s. Plates. Pp. v+102 plates. 26.8 rupees; 40s. 6d. (Calcutta: Bengal Secretariat Book Depot.)

Memoirs of the Geological Survey of India. Vol. 63, Part 1: The Geology of Sirohi State, Rajputana. By A. L. Coulson. Pp. vii+166+xxii+12 plates. (Calcutta: Central Book Depot.) 7.8 rupees; 12s.

Sudan Government. Annual Report of the Gezira Agricultural Research Service for the Year ended 31st December, 1932, relating to Experimental Results obtained in the Season 1931-32. Pp. ii+172. (Wad Medani.)

Scientific Reports of the Imperial Institute of Agricultural Research including the Reports of the Imperial Dairy Expert, Physiological Chemist and Sugarcane Expert. Pp. vi+165+3 plates. (Delhi: Manager of Publications.) 2.12 rupees; 5s.

Reports of the Great Barrier Reef Committee. Vol. 4, Part 1. Pp. v+36+7 plates. (Brisbane: Government Printer.)

Ceylon Journal of Science. Section D: Medical Science. Vol. 3, Part 2: Lorain's Infantilism, due to Arrested Development of the Pituitary Gland. By Prof. W. C. Osman Hill. Pp. 115-156+plates 17-25. (Colombo: Bacteriological Institute; London: Dulau and Co.) 3 rupees.

Ceylon Journal of Science. Section B: Zoology and Geology. Spolia Zeylanica. Edited by P. E. P. Deraniyagala and G. M. Henry. Vol. 17, Part 3, May 19. Pp. 149-250+plates 28-39. (Colombo: Colombo Museum; London: Dulau and Co.) 3 rupees.

The Hokkaido Imperial University. Calendar 1933-1934. Pp. 213. (Sapporo.)

Technical Books of 1932: a Selection. Compiled by Donald Hendry. (Twenty-fifth Issue.) Pp. 28. (Brooklyn, N.Y.: Pratt Institute Free Library.)

Fifty Years of Museum Work: Autobiography, Unpublished Papers and Bibliography of Dr. Frederic A. Lucas. Pp. x+81+5 plates. (New York City: American Museum of Natural History.)

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