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Constitution of the University of London.[1]

THE Royal Commission on University Education in London—the "Haldane Commission"—was appointed in 1909 and its final report was issued in 1913. In August 1913 a Departmental Committee was appointed to report as to the steps by which effect should be given to the scheme of the report of the Royal Commission, but that Committee abandoned its labours soon after the outbreak of War.

The Departmental Committee, which reported last month, was set up in October 1924 with Lord Ernle as chairman. In February 1925, however, Mr. Hilton Young was appointed chairman on Lord Ernle's retiring for reasons of health. The terms of reference to the Committee were:

"To consider the Final Report of the Royal Commission on University Education dated 27th March 1913, and, having regard to present circumstances and after consultation with the persons and bodies concerned, to indicate what are the principal changes now most needed in the existing constitution of the University of London and on what basis a Statutory Commission should be set up to frame new Statutes for the University."

In the introductory section of the report the Committee expresses high appreciation of the analysis and of the ideals presented by the Haldane Commission, but says:

"A careful examination of the Haldane Report and the knowledge which we have acquired of the progress and development of the University, particularly since the war, have led us to the conclusion that it would be impracticable to attempt to give effect to some of the major recommendations of the Commissioners. There are other recommendations which require modification to meet altered circumstances, and there are others, again, which the University has substantially adopted. . . . We conceive our terms of reference as conferring on us the duty of devising an immediately practicable scheme for the better government, organisation and development of the University to which effect may be given by way of a Statutory Commission, and we are convinced that with the lapse of time and material change of circumstances some of the main recommendations of the Haldane Report have lost their force, and that the ground for attempting to impose such an entirely new constitution on the University as the Report proposed no longer exists. A practicable scheme of reform and reorganisation must, in our opinion, be evolutionary rather than revolutionary and build as far as possible on existing foundations. Certain characteristics peculiar to the University of London have become firmly established, the University has developed greatly during the past twenty-five years, even though hampered by serious constitutional defects. For the removal of those defects we are obliged to recommend some fundamental changes."

[1] Board of Education: Report of the Departmental Committee on the University of London. Pp. 76. (London: H.M. Stationery Office, 1926.) 1s. 3d. net.

Approaching the problem in the spirit indicated by these passages from the report, the Committee has found it possible to present, in a relatively short report, its own reasoned views and recommendations, together with a discussion of the main points on which divergent views were submitted to it in oral or written evidence. The Committee confined its attention to broad constitutional issues; thus the question of where and how the central offices of the University should be housed—rather a prominent question at present—did not call for consideration by it.

The subject of the external side was considered early, and after discussion and inquiry of the value of the examinations for external students, the conclusion was reached that, "in the view of the whole Committee these examinations have in the past served, and will in future serve, a useful purpose." It is gratifying to learn that on the evidence before it the Committee noted with satisfaction the steady growth of understanding, interaction, and good feeling between the internal and external sides of the University.

Another section of the problem before the Committee —the question of incorporation—appeared, when examined closely, to present no serious difficulty. There are two, and only two, "Colleges incorporated in the University"—University College and King's College. The Haldane Commissioners were of opinion that incorporation should be extended. The Departmental Committee, with the history of thirteen more years on the table, does not recommend the incorporation of other colleges; at the same time it does "not urge the disincorporation of University and King's Colleges." The view is that colleges should "have liberty in agreement with the University to achieve either disincorporation or incorporation."

The pregnant chapters in the Report are those headed, respectively, "The University and its Colleges," "Finance," "The Government of the University," and "The Schools of the University." In these the Committee discusses the facts and considerations which have determined its recommendations as to certain changes in the constitution of the University. These chapters give an attractive, clear, terse and pointed account of the present position and of the advantages which the changes recommended are designed to secure. That account should be read as a whole, for the proposed constitution must be fully envisaged before its effectiveness can be estimated, and the objection or difficulty which may seem to affect it at one point may, in practice, be ruled out at another.

In due course the general scheme recommended as for the guidance of a Statutory Commission will no doubt be subject to criticism and suggestion. Indeed, on a point of primary importance—the only matter of divergence within the Committee—one member of the Committee has presented a 'minority report,' and on that point readers of the main report have in its text the grounds upon which all the other members of the Committee based their recommendations.

The recommendations of the Committee are summarised under twelve heads: (1) The Council, (2) The Senate, (3) Standing Committees of the Senate, (4) The Academic Council, (5) The Council for External Students, (6) The Collegiate Council, (7) The University Extension and Tutorial Classes Board, (8) The Matriculation and Schools Examinations Board, (9) Faculties and Boards of Faculties, (10) Schools of the University, (11) Examinations, (12) The Principal.

Of these, No. 6 would give effect to the view that the "Institutional Element of the University is sufficiently important and distinct to justify not only representation on the Senate, but also the creation of a special standing committee of the Senate." This committee, designated "The Collegiate Council," would consist of the Vice-Chancellor, the Principal, the seven members of the Senate appointed by seven named institutions, the two members appointed by the Medical Schools, with possible additional members added by the Senate as representatives of institutions or groups of institutions, the Principal of the University to be chairman of the Collegiate Council.

Recommendation No. 12 includes that the Principal

"shall have unrestricted rights of attendance and speech at all meetings of the Council [of the University], the Senate and the standing committees of the Senate, and it shall be his duty to assist them with his advice. He shall be Chairman of the Collegiate Council but he shall not be a member of the governing body of any School of the University."

It is not to be anticipated that these proposals will elicit any serious questioning, but the position, powers, and constitution of "The Council of the University," summarised in Recommendation No. 1, and the matters of policy and of administration which are set out in the Report as in relation to that recommendation, are sure to be subjected to searching examination. Recommendation No. 1 is therefore quoted here in full:

"There shall be a Council of the University consisting of:—The Chancellor, the Vice-Chancellor, the Chairman of Convocation, Six members appointed from their own number by the Senate, Four members appointed by the Crown, Two members appointed by the London County Council, One member co-opted at the discretion of the remainder of the Council.

"The Council shall control the finance of the University, and in particular it shall have final authority in the allocation of university funds, but in dealing with financial matters directly affecting educational policy it shall give the Senate a full opportunity of reporting.

"The Council shall have power to negotiate with, and receive money from, grant-giving bodies on behalf of the University as a whole and of any of the Schools of the University including the Incorporated Colleges.

"The Council shall appoint a Chairman from its own number."

With this should be read from Recommendation 2: "The Senate":—

"The Senate shall elect the Vice-Chancellor. . . .

"The Senate, subject to the financial decisions of the Council, shall control the educational work of the University, but it shall have power to delegate the performance of such duties as it thinks fit to its standing committees and other bodies."

In his minority report, Mr. Lees-Smith presents objections to the constitutional position of the Council as recommended by the Committee, and he recommends "that the representative Senate should be supreme in finance as in other fields, but should have a statutory 'Finance Council,' with the same membership as that proposed in the Report for the supreme University Council."

The recommendations which the Committee makes as to the constitution commend themselves at sight on the ground—a ground, however, to which the Committee does not refer—that the proposed allocation of functions follows in the main the lines that have proved satisfactory in all the newer universities of England and in all those of Scotland. The Report itself presents discussion, explanation, and argument which leave little strength in the objections that witnesses put to the ideas which the Committee had formulated as the inquiry proceeded.

It must be recognised that any argument from the success of corresponding schemes in other British universities does not really carry far; for in size and in complexity the University of London is *sui generis*. As to *size*: from the latest statistics published by the University Grants Committee it appears that, excluding Oxford and Cambridge from the totals, the London institutions comprised in the University of London had of full-time students 8955, while all other university institutions in England had 11,672. Of part-time students London had 7442; other institutions in England 3322. Again, the recurrent grants made by the University Grants Committee were: to London institutions, 376,270*l.*; to others in England, 386,800*l.* As to *complexity*, the Report of the Committee says:

"There are now 38 Schools of the University ranging from large colleges with several hundreds of internal students to small institutions with few or no internal students and including on the one hand colleges providing undergraduate instruction in nearly all the staple subjects of a normal undergraduate curriculum, and on the other institutions, or departments of institutions devoted entirely to postgraduate study or research in a limited range of subjects."

The recommendations of the Committee mean that the whole amount of the grants made by the University Grants Committee and by the London County Council in respect of constituent institutions of the University would be passed in block to the council of the reconstituted University for distribution as the council might decide. Thus in this important matter the proposed University Council would bear a responsibility with which that now resting on the council of any provincial university in England is as little comparable in scale as it is in complexity. It is to be noted, however, that as the Committee has pointed out, at several stages, not only before the determination of this block grant but also during its currency, the Council of the University would be in effective communication with the University Grants Committee, and further, that in "dealing with financial matters affecting educational policy the Council shall give the Senate a full opportunity of reporting." It might well be also that the smooth starting of the proposed new constitution would be effectively aided in practice by the observations with which the University Grants Committee announced its grant to the Council of the University.

The Committee appears to have tackled successfully the problem of presenting, in outline, a reasoned scheme for such amendment of the constitution of this great University as would provide machinery for its government and administration, sufficiently well-knit to avoid waste of effort, and sufficiently flexible to adapt itself to work in the varied fields in which the University operates.

There are, however, some considerations which, if not faced before effect comes to be given to the recommendations as a whole, may prove detrimental to the scheme. These turn on the fact, which is fully recognised by the Committee, that "the University on its teaching side is organised mainly on a collegiate basis." It is in this collegiate basis of its parts that the University of London differs essentially from the newer universities of England. The resources of its schools are in varying degree in the form of buildings, endowments, and fees and other income liable to fluctuation. A large part of the fluctuating income comes from the grants, national and local, which in the case of London the Committee recommends should be paid in block to the University for allocation to its colleges and other schools.

Now, some of these institutions perform valuable functions which are not regarded as university work; many of them have received, both for their university work and for their other activities, valuable annual support and liberal endowments from donors more

appreciative of specialised work than of the far-flung usefulness of the University. Not a little of this support has been given for work that is definitely university work but in particular institutions. Considerations turning on such facts as these are bound to give rise to ideas, and indeed fears, that would retard the development of the institution which the Committee desires to promote.

Relatively well-endowed or well-supported schools of the University may fear that the payment of grants in block for allocation within the University may in practice to some extent discount the benefits of their separate resources. Prospective benefactors may find in it reason to hesitate to be generous to a particular institution or in respect of particular aims which they desire to forward.

With the University in the hands of a well-constituted Council and Senate, such fears or hesitation should not materialise; but now is the time to prevent harm from their emergence. The Committee has aimed at an evolutionary rather than a revolutionary scheme of reform and reorganisation. Well-judged application of public support has been the dominant element in the environment of the several institutions of the University, and there should be no apparent risk of serious change or unsettlement in this influence. Some reassurance on this matter appears to be desirable, and it would be well that national and local grants continued to be at least earmarked in the initial stages of the proposed changes. Even now the list of recurrent grants made by the University Grants Committee shows that, in the case of provincial university centres, separate grants are made to six colleges—five in England and one in Scotland—each presumably doing good university work for its region although not incorporated in the university.

Italian Alchemical Manuscripts.

Sulle fonti storiche della chimica e dell' alchimia in Italia. Per Dott. Giovanni Carbonelli. Tratte dallo spoglio dei manoscritti delle biblioteche con speciale riguardo ai codici 74 di Pavia e 1166 Laurenziano. Pp. xix+218. (Roma: Istituto Nazionale Medico Farmacologico, 1925.) 300 lire.

THE great libraries of Italy form one of the happiest hunting-grounds for the seeker after ancient alchemical manuscripts. Dr. Ernst Darmstaedter's exciting discovery last year of a Latin version of Geber's "Book of Mercy," up to that time known only in its Arabic dress, is almost certainly merely a foretaste of what is to come. In the practically unbroken tradition of culture in Italy, extending over a couple of millennia, the accumulation of precious documents has found a peculiarly favourable atmosphere, and the International Committee which is now conducting a census of alchemical manuscripts in Europe will doubtless unearth its greatest treasures in the land of Dante—who consigned all alchemists to a special corner of the Inferno.

The part played by Italy in the scientific renaissance of the twelfth and thirteenth centuries and in the transmission of knowledge has scarcely received the recognition which is its due. In South Italy and in Sicily, under the Norman sovereigns, the translation of scientific works and the dissemination of learning went on apace; in Sicily, for example, the "Almagest" appears to have been translated for the first time into Latin from the original Greek, in 1160 or thereabout, while on the practical side it has been suggested with every probability of truth that the discovery of alcohol was made in South Italy in the tenth century. Although conditions in the northern portions of the country were not so favourable, the commercial relations between Venice and Pisa and various regions of the East led to the establishment of Italian colonies in Constantinople, and in this and other ways a transmission of knowledge and a steady intercommunication between scholars was rendered possible. Among the translators of the north of Italy may be mentioned Burgundio of Pisa, who translated ten books of Galen, and Pascalis Romanus, who, says Prof. C. H. Haskins, can be "almost certainly identified with the translator from the Greek, in 1169, of the curious book known as the Kiranides."

There is, therefore, every reason for great expectations from the Italian manuscripts, and particularly so when we recollect that Italy is also the home of painting. The Muslim dislike of representations of anything endowed with life reacted upon the illustration of books, with the result that very few figures of any sort are found in Arabic alchemical manuscripts; while in most of Europe the alchemists do not shine conspicuously as artists. Such delightful drawings as those which are found in a British Museum manuscript of the "Ordinall of Alkimy," by the Bristol alchemist Thomas Norton, are noteworthy as much for their rarity as their beauty, while in the printed books the figures of apparatus do not often reach the level of those in the 1545 Geber.

With our appetites thus whetted we may turn to Dr. Carbonelli's sumptuous volume and sample his fare. Our first impression is one of complete satisfaction, for it is produced by the sight of his numerous and very attractive illustrations. The coloured frontispiece is a reproduction of Giovanni Brueghel's picture entitled "Elemento del Fuoco," which was probably painted in 1608 for the Cardinal Federico Borromeo,

and shows a variety of chemical reagents and apparatus. The muffle in the centre of the picture would not look at all out of place in a modern laboratory, while the bottle of mercuric oxide occupies a position ominous of its future importance. Of the other illustrations we can refer to only a few. Those which offer the greatest appeal are Andrea Orcagna's fresco of the "Alchimisti e falsificatori" in the Tenth Bolgia of Hell, and the drawings of apparatus on pp. 133 to 138. There are also hypothetical portraits of Hermes, Geber, Avicenna and Galen, and a beautiful illuminated page from a manuscript of a work by Albertus Magnus. Altogether there are 242 photographic reproductions, splendidly executed and admirably selected, and for these alone the book is well worth the comparatively modest price asked.

When we leave the illustrations and turn our attention to the letterpress, our first impression of satisfaction will probably wear off. Dr. Carbonelli has unfortunately chosen to make excerpts from the manuscripts and to connect them up into a narrative. The effect thus produced upon the reader is one of exasperation, who either finds himself cut off in the course of a most interesting passage from the manuscript or else is suddenly plunged from Carbonelli into the middle of a treatise of the beginning of which he knows nothing. In spite of this regrettable habit, however, the author has succeeded in making his book attractive by his unerring instinct for the curious and unusual; perhaps no other book on alchemy in recent years has provided such varied and stimulating material. Thus, in Section IV., Dr. Carbonelli describes certain magical and alchemical manuscripts written on lead and silver. At Florence there is a manuscript of this kind, consisting of nine leaden leaves, pierced with two holes and held together by two cords and a little rod of lead. The writing is of the first half of the sixteenth century. On the first page, in Gothic letters, is inscribed: *Benedicta lapidem* (sic) *prima materia est.* Below is an equilateral triangle, and below that again the following phrase: *Ego sum Ambagasar quo dabo a tibi veri secretum secretissimum noster.* In the remaining leaves many of the well-known alchemical sentences occur, such as *Mercurius noster non est mercurius vulgi,* and *In rerum multitudine ars nostra non consistit.* Directions are given for preparing the elixir, which, in addition to its power of transmutation, will cure any incurable disease, "so that you may eat and live a long time upon the earth—supposing, that is, that you observe the Divine Laws."

A very valuable feature of the book is the inclusion at the end of several glossaries of alchemical names, extracted from manuscripts in the author's possession and elsewhere. The number of Arabic terms carried over bodily into medieval European alchemy is astonishing, and the corruption which they have undergone in many cases renders them almost unrecognisable in the absence of glossaries. Knowing, for example, that *leserab* means lead, it is not difficult to see that this word is a corrupt rendering of *al-usrub,* and when *anthigar* is said to signify borax, one can easily trace the derivation from *al-tinkar;* but it is doubtful if these and similar words could have been identified—at least with certainty—in the absence of a vocabulary.

As a whole, Dr. Carbonelli's book reminds us of a shop-window filled with the most attractive wares; we are fascinated by the treasures exposed, but we want to take them out of their setting and examine them carefully one by one and put them in a more suitable environment. Any chemist who feels that he cannot afford to give 300 lire for a book must on no account look at it, or he will inevitably break all resolutions of economy; if he does not succumb until p. 116, the double-page drawings there will certainly complete his downfall.

E. J. HOLMYARD.

The Winning of Petroleum.

Oil-Field Exploration and Development: a Practical Guide for Oil-Field Prospectors and Operators; with which is Incorporated a Discussion of the Origin and Distribution of Petroleum, and Notes on Oil-Field Legislation and Customs. By A. Beeby Thompson. In 2 vols. Vol. 1: Oil-Field Principles. Pp. xxiv + 546 + 32. Vol. 2: Oil-Field Practice. Pp. xxiv + 547-1177 + 32. (London: Crosby Lockwood and Son, 1925.) n.p.

THE subject of oil-field engineering is a difficult one to deal with in a radical manner within the space of two volumes, but whatever Mr. A Beeby Thompson's work may lack in this respect is more than compensated by the amount of information it contains. Whilst we may not have a great deal to learn from America in regard to the geological and refining branches of the petroleum industry, there is no doubt that oil-field practice there is considerably ahead of that adopted by British oil-field engineers. It is a little disappointing to find, therefore, that the author, who is as well acquainted with American drilling methods as the practice of other fields, has added very little to the information given in his earlier books on the subjects of drilling, fishing, and water exclusion.

In the first volume, more ground has been covered, in dealing with oil-field principles, than one would deem possible in the space available. The work of many investigators, augmented by the practical experiences of the author, has been brought to bear on the problems under discussion, but the arguments are inconclusive.

The chapter dealing with the origin of oil is well written, and the many theories advanced have been treated with great care. The formation of oil-fields makes interesting reading, but we would wish the portion dealing with the causes of oil-field pressures had been treated in more detail.

Whilst there are many books on geology, few of them deal with that portion of the science which is applied to the location and winning of petroleum, and the sound, practical hints on oil-field mapping, together with the chapter on oil-field structures, should prove of extreme interest and value to the student and beginner in this branch of the industry. The important bearing which surface indications have on such work is exemplified in detail, particularly in regard to mud volcanoes, petroleum seepages, asphaltic deposits, and the general association of sulphurous and saline waters with petroliferous areas, but the conclusions to be drawn from such indications are dismissed in a very few pages.

Much valuable information is brought together within a small compass in the chapters which concern the geology of the various oil-fields throughout the world. Particulars of many of the fields given have not been available in book form hitherto. These chapters are undoubtedly the best in the first volume. The book has been written as "a practical guide for oil-field prospectors and operators," and we feel that the chemical and physical properties of natural hydrocarbons are not dealt with in a sufficiently fundamental manner to serve the purpose intended. In the refining portion, the author deals with the effect of open steam and vacuum distillation clearly, but beyond describing briefly one continuous method of distillation, the reader is left with the impression that the distillation and refining of petroleum generally is a comparatively simple matter.

Errors which should be corrected in any future edition are the reference to the Edeleanu process and to the use of adsorptive materials for the purpose of refining, as being chemical methods; and the reference to cracking in the vapour phase as a commercial proposition. We feel this portion of the book scarcely does justice to the author or those engaged in the refining branch of the petroleum industry.

The second volume, on oil-field practice, is appreciated all the better for keeping until last. The descriptive matter relating to the various methods of oil-well drilling and lining contains much information, notable features being the Hild differential gear for controlling and maintaining torsion on the 'rotary' stem below an arbitrary limit, and a short reference to coring. The specifications for the different types of drilling outfits should prove of use to the field-man.

One point stressed by the author will receive the approbation of all production engineers of experience, namely, the present necessity of employing the services of scientifically trained junior geologists for the collection, examination, and description of samples of the formation passed through. "The driller's phraseology no longer conveys as much information as modern research demands."

Methods of recording and analysing drilling and producing records, not only for immediate use, but also for estimating purposes in the future, and the tabulated drilling costs on various oil-fields, particularly those of recent date, are some of the outstanding features of this volume.

The havoc wrought in many fields through overlying and lower waters entering oil-sands, and how this might be obviated by adopting a uniform casing programme throughout the field, is clearly shown with the aid of a diagram, and is worthy of note by men of experience. Attention is also directed to the danger to casing, in position, of corrosive waters, and also to the importance of chemical analyses of oil-field waters with the view of their identification. These chapters, together with those dealing with the location and isolation of oil-field waters and the various methods employed for the recovery of petroleum, which comprise the bulk of the second volume, prove the author to be a man of wide experience in methods of production. His experiences confirm the opinion shared by many petroleum technologists of experience that the responsibilities of the production superintendent are as great as, if not greater than, those of the drilling superintendent.

Mr. Beeby Thompson's views on oil-field equipment, particularly where internal combustion engines and electric power for oil-field purposes are dealt with, are welcome in literature of this kind, as the application of electricity to production work is still in its infancy. With the necessity for housing oil-field workers in comfortable and sanitary camps, particularly in the tropics, every one will agree, and valuable suggestions are made with this in view. More space might have been devoted to the Chambeau system of sewage disposal for the benefit of those situated in isolated places who are unfamiliar with sewage problems generally, and this simple, but effective, method in particular.

Useful information concerning the design of pumping plant and frictional losses in oil pipe-lines is included, and the chapter on natural gas gives a clear insight into the methods of casing-head gasoline absorption and gas transmission. The work is completed by an appendix giving tables and data which all petroleum technologists will find useful.

As a compilation of facts and knowledge augmented

by the personal experiences of the author, the work can be recommended especially to petroleum students and those about to enter the industry, as it deals largely with information of a practical character which scarcely comes within the purview of an academic teacher on the subject, and many of the chapters will prove of interest to the production engineer of experience. The book is well illustrated, and those desirous of pursuing further any of the questions under discussion will find ample and complete references.

ALFRED W. NASH.

The Smoke Problem.

The Smoke Problem of Great Cities. By Sir Napier Shaw and Dr. John Switzer Owens. Pp. xvi+301. (London: Constable and Co., Ltd., 1925.) 22*s.* 6*d.* net.

IT is a significant fact that the thing which first strikes the foreigner on visiting large cities in Great Britain is the smoky atmosphere and the grimy appearance of the buildings. He wonders how we can tolerate such an environment. It is true enough that most of us do so, and it may be, as one writer has said, "that thousands of people live their lives from start to finish in the midst of black smoke and have come to regard it as a normal condition of life." Nevertheless, there is a small section of the community who feel very differently on the subject, as the growing mass of literature on the smoke nuisance testifies. The latest contribution is a treatise on the smoke problem of cities by Sir Napier Shaw and Dr. Owens, who for many years have devoted their attention to the estimation of atmospheric impurities in London and other large towns. The most interesting section of the volume is the record of these experiments, namely, the measurements by the standard gauges, which have been set up in various towns, and the results obtained with the dust filter and the jet dust counter, all of which have already appeared *in extenso* in the reports of the Committee on Atmospheric Pollution of the Meteorological Office. The volume includes also a good deal of information borrowed from other sources.

The standard gauge consists of a circular stoneware funnel of 30 cm. diameter, which is inserted into the neck of a large bottle, and the solid deposit which is carried down by rain or blown in by the wind is estimated at stated intervals throughout the year. The character of the deposit varies considerably in different towns, and will naturally depend on the situation of the gauge and the rainfall. For example, the deposit at Malvern, a residential town in a rural district, contains so much as fifty per cent. of wind-blown mineral matter. The soot, amounting to eight per cent., which is estimated by the loss of weight on ignition of the deposit (and may very well contain vegetable matter), curiously enough is free from tar, although the authors find so much as 37 per cent. in domestic soot. The result, as indicative of atmospheric pollution in different towns, cannot be regarded as altogether trustworthy, and I would suggest as a more satisfactory method, the collection of the permanent tarry deposit on glass plates which could be roughly but rapidly estimated by the amount of light obscured from a standard lamp. For the tarry deposit, for which the domestic hearth is mainly responsible, is cumulative in its destructive and disfiguring effects. The free acid, another destructive agent, might also be estimated in the rain water.

There is one statement which, though probably correct, is somewhat misleading, namely, that the soot suspended in the air is not removed by rain. There is no doubt, however, that soot is absorbed by clouds, as it is by fog, and the former when resolved into rain will carry down considerable quantities of soot. Snow will do the same. The chapter on the dust filter and automatic recorder designed by Dr. Owens is one of considerable interest and importance, and probably affords a more satisfactory estimate of air pollution than the gauge referred to. It is an apparatus for filtering a measured volume of air through white filter paper and estimating by the shade of the deposit the extent of impurity. By an ingenious modification the instrument is rendered automatic, so that hourly records can be taken if necessary without supervision. The jet dust counter is a modification of Aitken's dust counter, by which particles of dust are deposited on a cover glass and can be examined microscopically. In this way some curious observations have been made on the nature of the more minute atmospheric particles.

In addition to the above, the authors have collected information on the industrial uses of smoke, on the use of different kinds of smokeless fuel, on the remedy for industrial smoke and a summary of the recommendations of Lord Newton's committee. The latter is a useful addendum; for the report has been very sparsely circulated and is now out-of-print. The book is the most comprehensive account of the subject which has yet appeared. But unfortunately its very comprehensiveness makes the price prohibitive to the ordinary individual whose co-operation is so essential, if this pestilential nuisance is ever to be seriously tackled. The following paragraph is from the recent report of the Coal Commission:

"We would observe that the three million tons of soot which it is estimated by the Commission are discharged into the air annually are equal in weight to nearly three days' output of all the collieries of Great Britain. In effect the work of over a million for three

days every year is devoted to providing the soot which pollutes our atmosphere."

When one realises that raw coal and coke may and should be burnt in boiler furnaces without smoke, that gas-coke may replace raw coal for domestic use (I use nothing but gas-coke for hot water and heating the living-room), the production of smoke seems a criminal waste of our fuel resources, apart from the heavy cost in health, in the destruction of vegetation, disintegration of masonry and metal work, deterioration, so I am told, of valuable oil paintings, and the outlay in washing and repainting. J. B. COHEN.

Mammalian Palæontology.

Text-Book of Palæontology. By Karl A. von Zittel. Vol. 3: *Mammalia.* Revised by Dr. Max Schlosser. Translated under the direction of Dr. Charles R. Eastman by Lucy P. Bush and Marguerite L. Engler. Translation revised, with Additions, by Sir Arthur Smith Woodward. Pp. viii+316. (London: Macmillan and Co., Ltd., 1925.) 25*s.* net.

THE completion, after twenty-five years, by the issue of a volume dealing with mammals, of that translation of v. Zittel's "Grundzüge der Paläontologie" for which the late C. R. Eastman was responsible, is creditable to its publisher, and may, we hope, be a symptom of a renewed interest in palæontology in Britain.

The "Grundzüge" is the one essential book to the working palæontologist, because it lists the great majority of genera of fossil vertebrates, indicating the more important synonyms and referring them to families. Of these families, and all larger groups, short and usually excellent diagnoses are provided; only those who have never endeavoured to draw up similar condensed statements of the characters which define groups will complain that some of the animals do not really exhibit the 'diagnostic' characters of the groups within which they are included. To these descriptions are added more detailed accounts of the structure, in the main naturally of the skeleton, and sometimes indications of phylogeny; and the book ends with an excellent general account of the distribution in space and time of the more important mammals.

The title adopted for the English edition, a "Text-Book of Palæontology," neither correctly translates the German title nor expresses the character of the book. Consisting as it does of a mass of facts with no indication either of methods of work or of the general theory of the subject, it is by itself of little use to the beginner, and requires to be supplemented in some way, either by a teacher or by some, as yet unwritten, introduction.

Of the German version, four editions have appeared, the last in 1918 and 1923, and a fifth is in preparation. The present translation, which was left nearly all in type, though unrevised, at the death of Dr. Eastman in 1918, has been to some extent brought up-to-date by Sir Arthur Smith Woodward. This long delay has, however, resulted in the omission of many important discoveries recorded in the German edition of 1923. Of these the most serious is that of all reference to the work of Dr. Pilgrim, work which is fundamental in that it gives us an understanding of the age of the successive faunas of India, and for the first time enables us to use them in discussion of phylogeny and of migration.

There are many other omissions of important finds: Broom's account of the skull of Polymastodon; Dr. Matthew's Eodelphis, Palæoryctes, Zanyrictes; Stehlin's so-called Chiromyids; Osborn's skulls of Bathyopsis and Eotitanops, all things of first-rate importance published before 1923, are not referred to. The American and Swedish work on the fossil mammals of China and Mongolia is perhaps too recent to expect. Finally, it may be pointed out that the German volume containing the lower vertebrates in addition to the mammals costs 18*s.*, whilst the two corresponding English volumes are 50*s.* D. M. S. WATSON.

Our Bookshelf.

Principles and Practice of Farm Book-keeping: a Text-Book for Agricultural Students. By Leonard F. Foster. Pp. viii+476. (London: Gee and Co. (Publishers), Ltd., 1925.) 15*s.* net.

THE time has come when farmers and accountants must study each other's requirements, for the business of farming cannot now be conducted by the free and easy methods of the past. The farm requires special consideration in its book-keeping department, for in that, as in many other things, it differs widely from the ordinary undertakings of commerce. Farmers who have sought the aid of accountants in coping with their book-keeping problems have very often been unable to obtain that meed of help which they may have expected, because the ordinary cut-and-dried methods of account have not been varied to meet their special need. It is probable that the demand for special agricultural accountancy is only now becoming strong enough to make itself felt, and Mr. Foster's book is one of the first serious attempts by a qualified accountant to expound the principles of book-keeping as applied to the farm departments.

It is a welcome book, because there are a large number of people, students and practising farmers alike, who are looking for something of the sort. It is a good book, because it covers the subject with which it professes to deal, and develops it in easy and definite stages from the first broad principles to the special technical applications found in agriculture. It contains a wealth of illustration in the form of specimen accounts,

and the method of expression used is at once clear and sufficiently human to maintain the reader's interest.

Mr. Foster is careful to state that his work does not do more than touch lightly on the subject of farm costing. The difference between financial and cost accounts is not always clearly seen by persons who are new to book-keeping. Theoretically both may be necessary to the really efficient management of a large holding, but for the immediate purposes of sound trading and daily guidance, it is the financial accounts which are so very important. It is to be hoped that more accountants will follow Mr. Foster's example and develop the subject of farm book-keeping to the mutual benefit of their rural clients and themselves.

C. H.

The Science of Soils and Manures. By J. Alan Murray. Third edition, revised and enlarged. Pp. xiv+298. (London: Constable and Co., Ltd., 1925.) 12*s.* 6*d.* net.

THE third edition of this text-book, issued under a slight change of title, aims at bringing its subject up-to-date for the use of students of advanced university standard. The considerable recent advances in our knowledge of soil structure and chemistry, and in the bearings of soil biology on plant growth, have been incorporated, compensation of space being made by judicious omissions of certain ideas and methods which are either out-of-date or have failed to fulfil their promise of usefulness. A concession to more advanced students is made by the inclusion of pertinent mathematical data in the appendix, to which are also removed from the text various tables only required for occasional reference, whereby the handiness of the book is considerably increased.

Certain features of the work deserve special commendation. The horticultural, as opposed to the agricultural, aspect of the fertiliser problem is considered, and manurial tables are included applicable to garden crops, of which the requirements vary considerably. Attention is given to the various manufacturing processes of artificial fertilisers, with illustrations of plant actually in use, thus enabling the student to obtain a clearer idea of what he is really dealing with when applying manures. A useful chapter on fertiliser valuation is included, concrete examples being given, illustrating the misleading nature of the system of unit prices, and showing simple methods by which the actual value of fertilisers to the farmer can be calculated.

W. E. B.

Outlines of Qualitative Chemical Analysis. By Prof. Frank Austin Gooch and Prof. Philip Embury Browning. Fifth edition, revised. Pp. viii+184. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1924.) 7*s.* 6*d.* net.

THIS work supplies a "systematic scheme of analysis" for the usual set of commoner basic and acidic ions. One would like to see these somewhat hackneyed limits extended to include a few 'rare' elements. It is difficult to know where to stop, but surely it is time that ordinary courses in chemistry dealt with such commercially important elements as, for example, titanium, molybdenum, tungsten, and possibly even thorium.

So far as it goes, the book deals excellently with the subject. An introductory chapter treats briefly but well of the ionic principles underlying the reactions; and the usual systematic examination, condensed into tabular form with commentaries on important points, is supplied with ample references to this first chapter. The methods given are well arranged and up-to-date, and a student who works carefully through them and answers the questions set should learn some chemistry as well as 'tests.' The book is marred by a final short chapter on some haphazard tests for a few commoner organic compounds—acids, alcohols, sugars, alkaloids—a chapter which, with little system and no instruction in principles, is decidedly inferior to the preceding matter.

The book is well turned out, and few printing errors have been noticed.

T. W. H.

Half-Hours with the Telescope: a Popular Guide to the Use of the Telescope as a Means of Amusement and Instruction. By R. A. Proctor. Revised and brought up to date by Dr. W. H. Steavenson. Pp. xii+131+7 plates. (London: Longmans, Green and Co., Ltd., 1926.) 5*s.* net.

THIS is the fifteenth impression of this book since its inception in 1868. Under Dr. Steavenson's revision, a number of necessary corrections and additions have been made with the view of continuing its former usefulness. New illustrations have been substituted throughout. It may be mentioned that the book is essentially one for the amateur possessing a telescope which he is prepared to use. He will then find in this little publication an excellent guide to the many objects of interest within reach of modest telescopic means, together with a simple account of the construction of his instrument and valuable hints for its successful use. The book is of pocket size, and the type is clear. There are, however, a few misprints, as on pp. 59, 70, and 107. A brief note on the nomenclature of the stars, or a reference to the British Astronomical Association Handbook for 1924 (in which all star catalogues are briefly described), would have been helpful to the beginner. From a cursory glance at the pages, the would-be purchaser might be inclined to object to the price, but its worth will be readily admitted by a purchaser who, with its aid, has spent some very profitable half-hours with his telescope.

Sympathetic Training of Horse and Man. By Major T. S. Paterson. Pp. xi+205+8 plates. (London: H. F. and G. Witherby, 1925). 12*s.* 6*d.* net.

THIS book is described as "a Handbook on Present-day Training in Equitation," and, as the title indicates, it includes the necessary training of both man and horse in the methods by which that remarkable sympathy between horse and man can be established. As the author so admirably shows, successful equitation depends on the establishment of this link. Scientifically, we may be permitted to doubt whether the material indications of intention (the rein, spur and so forth) are the true media of communication between man and horse. The manner in which the dog, too, divines his master's mind, is scarcely capable of simple explanation. A well-written and attractive book.

Letters to the Editor.

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

Spinning Electrons and the Structure of Spectra.

RECENTLY Uhlenbeck and Goudsmit (NATURE, February 20, p. 264; see also *Naturw.*, November 20, 1925) have directed attention to the fact that a number of features of multiplet structure and the anomalous Zeeman effect can be described by assuming the electrons in the atom to possess an inherent magnetic moment, pictured as being due to a spinning motion of the electron about an axis of symmetry. This moment must be considered as having a magnitude of 1 or 2 Bohr magnetons (about 10^{-20} c.g.s. units), depending on what rules one assumes to govern the orientation of the axis with respect to an external magnetic field. The above-named authors discuss the advantages which such a view brings with it, but fail to point out some serious difficulties.

If it is permissible at all to use pictorial concepts such as the word 'spinning' evidently implies, it must also be permissible to speak of the 'dimensions' of an electron. These dimensions would then have to be taken as of order of magnitude 10^{-13} cm. To give a magnetic moment around 10^{-20}, the internal velocities would have to be exceedingly close to that of light. Now the elementary unit of magnetic moment, the Bohr magneton, is derived from considerations of the *orbital* motions of electrons with velocities *much smaller* than that of light (W. Pauli, jun., *Zeit. f. Phys.*, 31, 373, 1925), in which the internal structure of these electrons does not enter at all, so that they can be regarded as point charges. It is hard to see, then, why this elementary unit should also be characteristic of the internal motion of the electrons in spite of the high velocities involved, and that with a precision which would have to be considerable, if the measurements on the anomalous Zeeman effect were to be explained in this way.

Quite aside from this objection, the validity of which could perhaps be questioned, since we may not be justified in applying the classical concepts of kinematics and electrodynamics to the case of the structure of the electron, even if we only wish to obtain rough estimates, the following difficulty arises. In order to account for the observed Zeeman effect by the hypothesis of Uhlenbeck and Goudsmit, it is necessary to assume that an orbital electron always has the same magnetic moment, of the order of a Bohr magneton, no matter in what orbit or in what atom. One is thus led to expect that this also remains true when an electron forms part of the nuclear structure. But then the nucleus, too, will have a magnetic moment of the order of a Bohr magneton, unless the magnetic moments of all the nuclear electrons just happened to cancel. For such an additional moment of the nucleus there is no place in the theory of the Zeeman effect, and the probability that in all atomic nuclei the magnetic moments of the electrons neutralise seems *a priori* to be very small.

The new hypothesis, therefore, appears rather to effect the removal of the family ghost from the basement to the sub-basement, instead of expelling it definitely from the house. R. DE L. KRONIG.

Columbia University,
New York.

Theories of Adsorption and the Technique of its Measurement.

SEVERAL years of measurement of sorption in the University of Bristol laboratory by the simple and searching method of the sorption balance (for description see *J. Am. Chem. Soc.*, 1924, 46, 2781, and March 1926, 48, 690) have taught us two things: First, most of the published data on the sorption of gases and vapours possess no quantitative significance because they refer to insufficiently cleaned surfaces. Second, the behaviour of a surface when cleaned from pre-existing impurities assumes a different and highly significant form. It is usually supposed that mere heating of a substance like charcoal to, say 400°, with exposure to an ordinary vacuum, will completely remove previously sorbed gases. This is by no means the case. For example, carefully prepared sugar charcoal, which had been activated by superficial oxidation at about 1200°, was given an exposure for five hours at 450° to a vacuum of 10^{-5} mm., and was afterwards found to sorb a maximum of 17·5 per cent. of its own weight of nitrous oxide in a protracted series of experiments. The amount of nitrous oxide sorbed was raised to no less than 26·5 per cent. by the simple expedient of re-evacuating the charcoal at 450° after its saturation with nitrous oxide, and then repeating the measurements. Similar behaviour has been observed in many other cases; for example, the observed sorption of such inert substances as hexane or decane may be increased several fold by repeating the evacuation after the charcoal has been saturated with the hexane or decane to displace other impurities from the surface.

It is evident that published data are too uncertain in magnitude to permit of accurate comparison of the sorption of various substances for the testing of conflicting hypotheses. The second influence of these neglected residual impurities is to change the character of the curve representing the dependence of the sorption upon the pressure or vapour pressure. The ordinary form of sorption curve as obtained in the presence of tenaciously sorbed impurities shows steady increase with increase of pressure. The same surface when cleaned gives not only much greater sorption, but also the sorption is practically complete at comparatively low pressures, remaining constant at a saturation value as the pressure is further increased. With methyl alcohol and with toluene, for example, the pressure of the vapour can be increased five to twenty fold without appreciable increase in the amount adsorbed once the saturation value has been attained. Moreover, the adsorption on clean surfaces is nearly instantaneous and is perfectly reversible. It therefore becomes evident that the existence of a saturation value for sorption of vapours by charcoal is normal and characteristic.

There are at present three competing theories of adsorption: First, the monomolecular films of Langmuir (1916), Henry (1922), and others, in which interaction is confined to molecules of gas or vapour in actual contact with molecules of the surface; second, the polymolecular films of Polanyi (and Williams, *Proc. Roy. Soc.*, A, 1919, 96, 307) and Lamb and Coolidge (1920), where it is assumed that at distances many molecular diameters away from the solid surface, there is still a powerful attraction of gas or vapour molecules towards the surface, producing a film of compressed gas or even liquid; third, the capillary condensation hypothesis of Gurwitsch, 1915, and Patrick, which assumes that liquid is condensed in bulk in the pores of a porous solid such as charcoal or silica gel.

The objections to the Gurwitsch-Patrick hypothesis as a general theory are that it ignores the existence of adsorption upon plane non-porous surfaces, and that it does not account for the adsorption of the layer of molecules of liquid in actual contact with the solid. Furthermore, calculation from the well-known thermodynamic formula connecting vapour pressure with pore diameter for a liquid in a capillary shows that the greater part of adsorption is observed at pressures so low as to correspond with pores of diameters comparable with molecular magnitudes. Hence, even from this, one may argue that here true adsorption is responsible because the adsorbed molecules are all in direct contact with the molecules of the surface. Of course, whenever a surface coated with a mono-molecular film is shaped as a pore and exposed to nearly saturated vapour, liquid may condense in such a capillary.

The evidence for the thick compressed film of Polanyi is weak. The unknown constants of the formulæ based upon the assumption of a multimolecular film are determined by using some of the actually measured sorption data; and the expression then fits the remaining sorption data at other temperatures, etc. However, any one of the other theories will do as much. Again, many experiments have shown apparently thick films, but only with materials such as tarnished metals, glass that had been washed out with water, etc., where the true surface was unknown. Williams's derivation indirectly led to a determination of the thickness of the adsorbed layer; and he found from his study of existing data for gases and vapours that the thickness was of molecular magnitude except in the case of charcoal exposed to saturated vapour of liquid argon, where alone it corresponded to several molecules thick. Further, Henry's formulæ for monomolecular films are closely similar to those of Williams.

Much direct evidence has been brought in support of the monomolecular film hypotheses. The films postulated differ greatly in respect of packing, relation to the structure of the solid, nature of the binding force, whether truly chemical or due to physical forces or residual valency, etc., but they are alike in explaining all forms of adsorption as due to direct attachment of the adsorbed molecules to the solid surface. The striking fact that in our normal sorption curve the adsorption is practically completed at relatively low pressure affords new and almost conclusive support for the hypothesis of a monomolecular film.

JAMES W. McBAIN.

University of California,
Berkeley, March 19.

Abraham de Moivre.

IN interesting and valuable communications to *Biometrika*, of the final issues for 1924 and 1925, Karl Pearson set forth certain facts (not all new) which will doubtless result in Abraham de Moivre occupying a more important place than before in the history of mathematics. The results are reached by a careful study of: (*a*) "James Bernoulli's Theorem," and (*b*) a publication of Moivre dated November 12, 1733. Regarding this publication Pearson makes certain statements which require comment, since from them wrong inferences might readily be drawn.

This publication is entitled: "Approximatio ad Summan Terminorum Binomi $(a+b)^n$ in Seriem expansi" and was found bound in with one copy of Moivre's "Miscellanea Analytica," 1730. Pearson remarks:

"Many copies of this work have attached to them a *Supplementum* with separate pagination, ending in a table of 14 figure logarithms of factorials from 10! to 900! by differences of 10. But only a *very few* copies [P. tells of only the one] have a second supplement, also with separate pagination (pp. 1-7) and dated Nov. 12, 1733. This second supplement could only be added to copies sold three years after the issue of the original book, and this accounts for its rarity. Dr. Todhunter in writing his *History of the Theory of Probability* appears to have used the 1730 issue of the *Miscellanea Analytica*, and so never came across this supplement."

Pearson here seems to make two slips: (*a*) in assuming that because this "second supplement" is bound at the end of a copy in the University College Library, it was really a second supplement; (*b*) in stating that this publication was not considered in Todhunter's "History." As a matter of fact, this 'second supplement' appeared in English, except for minor changes, in both the second and third editions of Moivre's "Doctrine of Chances," 1738 and 1756. Todhunter considers this on pages 184, 192, 193 of his "History." Curiously enough, in the latter part of his first article, after having indicated the results of the 'second supplement,' Pearson remarks: "The same matter is dealt with twenty-three years later in the edition of 1756 of *The Doctrine of Chances*, pp. 243-250. Todhunter in his *History of the Theory of Probability*, Arts. 324 and 335, passed over the topic most superficially." Did Pearson overlook that a translation of his 'supplement' was thus dealt with in 1756 by Moivre and in 1865 by Todhunter? That this translation appeared also eighteen years before was manifestly not recognised.

Moreover, Moivre prefaces his translation with the statement (which Todhunter quotes): "I shall here translate a Paper of mine which was printed November 12, 1733, and communicated to some Friends, but never yet made public, reserving to myself the right of enlarging my own thoughts as occasion shall require." Hence it is clear that the publication in question was not a 'second supplement' to Moivre's "Miscellanea Analyitca," but was first 'made public,' and in English, in 1738. A facsimile of this pamphlet is to appear in an early number of *Isis*. It would be interesting to learn if any other copy of Moivre's original pamphlet is in existence.

RAYMOND CLARE ARCHIBALD.

Brown University,
Providence, R.I.,
February 22.

I am glad that Prof. Archibald's letter enables me to return to the subject of De Moivre's claim to be the first discoverer of the normal curve of errors usually attributed to Laplace or Gauss.

I do not think from what Prof. Archibald has written that he can have seen what he thinks—and possibly may be—the unique copy of the "Approximatio ad Summan Terminorum Binomi." It is in the same type and has the same characteristic species of tailpiece as the "Miscellanea Analytica." It has the same unusual form of pagination as the first "Supplementum"; it is printed on the like paper and is of the same format as the first "Supplementum" and the "Miscellanea." About half the known copies of the "Miscellanea Analytica" have *not* the first supplement, and I think it quite probable that the "Approximatio" was only bound up with a few last copies of the "Miscellanea Analytica" issued after November 1733. At any rate, that is where I should seek for it *first*. I said in my paper that De Moivre treated of the same matter in his "Doctrine of Chances," 1756, because that was the edition I was working with. Prof. Archibald rightly says that it

was also treated of in the 1738 edition, and then speaks as if the matter in the 1738 "Doctrine of Chances" and again in the 1756 edition was a mere translation "except for minor changes." This is not correct; for the history of statistics most important additions were made in both the 1738 and 1756 editions. The important principle of the 'activating deity' maintaining the stability of statistical ratios does not occur in the 1733 "Approximatio"; it first appears tentatively in the 1738 "Doctrine," where the seven lines of Corollary X are increased to nearly fifty lines, while in the 1756 "Doctrine" this corollary alone occupies some four pages or about 160 lines. Indeed the 6½ pages of the "Approximatio" become 11½ pages (of more lines) in the 1756 "Doctrine." As De Moivre appropriately observes, he has reserved to himself "the right of enlarging my own thoughts." That enlargement, developing Newton's idea of an omnipresent activating deity, who maintains mean statistical values, formed the foundation of statistical development through Derham, Süssmilch, Niewentyt, Price to Quetelet and Florence Nightingale. These may be mathematically 'minor' points, but they are vital for the history of statistics, and my reference to these additions in the penultimate paragraph of my paper might have shown Prof. Archibald that I was aware of the differences between the original "Approximatio" and the same dealt with in the "Doctrine of Chances." My error lay in not recognising that in the 1738 "Doctrine," the 6½ pages had grown to a little over 8, to become 11½ pages eighteen years later.

As to Dr. Todhunter, I have nothing whatever to retract in my judgment. In his Art. 335 he misses entirely the epoch-making character of the "Approximatio" as well as its enlargement in the "Doctrine." He does not say: Here is the original of Stirling's Theorem, here is the first appearance of the normal curve, here De Moivre anticipated Laplace as the latter anticipated Gauss. He does not even refer to the manner in which De Moivre expanded the Newtonian theology and directed statistics into the channel down which it flowed for nearly a century. Almost everywhere in his "History" Todhunter seizes a small bit of algebra out of a really important memoir and often speaks of it as a school exercise, whereas the memoir may have exerted by the principles involved a really wide influence on the development of the mathematical theory of statistics, and ultimately on statistical practice also.

Todhunter fails almost entirely to catch the drift of scientific evolution, or to treat that evolution in relation to the current thought of the day, which influences science as much as science influences general thought. The causes which led De Moivre to his "Approximatio" or Bayes to his theorem were more theological and sociological than purely mathematical, and until one recognises that the post-Newtonian English mathematicians were more influenced by Newton's theology than by his mathematics, the history of science in the eighteenth century—in particular that of the scientists who were members of the Royal Society—must remain obscure.

KARL PEARSON.

March 18, 1926.

Muscular Contraction.

IN the *Proceedings of the Royal Society*, Ser. B. Vol. 99, No. 694, December 1, 1925, W. E. Garner has published a paper that has interested us very much, because we are studying the possibility of a similar theory of muscular contraction. There is, however, sufficient difference in the mode in which we formulate our theory to make it worth while to describe our hypothesis. Moreover, we have succeeded in several experiments in producing evidence in support of our suppositions.

A first point of importance is, that measurement of the size of the fibrils in skeletal muscle seems to indicate that the total surface is larger than 20,000 sq. cm. We found that the distance of the transversal discs in muscles of rabbits was $1{\cdot}8\mu$ ($\pm 0{\cdot}1$) and the distance apart of two longitudinal fibrils $0{\cdot}8\mu(\pm 0{\cdot}1)$. From these values it is possible to calculate that the total surface of the fibrils in one gm. of muscle is 5 sq. m. or less and the surface of the transversal discs (both sides) 1·0 sq. m. In close agreement with these numbers is the surface occupied by all the lipoids extracted from 1 gm. of muscle when spread out on a large water surface and measured on the Adam-Langmuir apparatus. Twelve experiments gave results between 6·7 sq. m. and 7·1 sq. m. This agreement already indicates that the lipoids are spread out in a mono-molecular layer on the surface of the fibrils (and perhaps also of some transversal discs). (Cf. our paper on the bi-molecular layer of lipoids on chromocytes, *Journ. of Exp. Medicine*, 1925.)

Now when we make these same measurements in heart muscle of rabbits, we find much smaller distances between the fibrils, which are about half of those indicated in rabbit skeletal muscle. It is also a remarkable fact that the surface occupied by the lipoids from 1 gm. of heart muscle is about twice as large as that occupied by a similar extract of skeletal muscle. We found 16·6 sq. m. to 17·8 sq. m. in heart muscle.

The change of this lipoid film seems to us a very important phenomenon in muscular contraction. We would suggest a hydrogenation of the lecithin-kephalin molecules that form the principal fraction of the lipoid of muscle (only $\pm\frac{1}{10}$ is cholesterol) under the influence of hydrogenation and the formation of hydro-lecithin and hydro-kephalin. The effect would not only be a change in size from 2 to 1, but also a change in rigidity of the surface of the fibrils. A simple calculation shows that by a change of the total surface of an element having the dimensions $0{\cdot}8 \times 0{\cdot}8 \times 1{\cdot}8\mu$, into one of the dimensions $0{\cdot}8\ V2 \times 0{\cdot}8\ V2 \times (1{\cdot}8/2)\mu$, has the effect of decreasing the surface V2 times. We are therefore able to explain the shortening of a muscle fibril to half its length by changing 1·4/2 part of the total surface from lecithin into hydro-lecithin. For, as Leathes has shown, the spreading of the molecule of lecithin is 114×10^{-16} sq. cm., whereas hydro-lecithin gives half this value: 56×10^{-16} sq. cm. Lecithin is semi-liquid and hydro-lecithin a solid crystal powder.

Now it is clear that lactic acid cannot produce this change from lecithin into hydro-lecithin. It can be shown, however, that lactic acid, formed in the anærobic phase of the muscular contraction, has another influence. It acts on the protein in much the same way as hydrogen acts on lecithin in the presence of a catalyst.

It is possible to determine the total surface on water occupied by a certain portion of a protein extract from muscle when spread out on a water surface. In a great number of experiments we were able to show that a protein solution from the skeletal muscle of the rabbit always occupies the same surface on water, the nitrogen content of the extracts being equal. Taking 34,000 as the molecular weight of these proteins, we always find a surface of $\pm 1400 \times 10^{-16}$ sq. cm. for each molecule, which enables us to calculate a thickness[1] of $\pm 30 \times 10^{-8}$ cm. at zero-pressure (extrapolated).

[1] This value is independent of the molecular weight.

From this number and from the protein content of the muscle, it is possible to calculate that the total surface of all the protein of 1 gm. of muscle would be ± 50 sq. m., assuming that all the protein is in the same condition as the protein on the water surface (a highly improbable supposition). Now lactic acid —like other acids—has a striking influence on the size of the area occupied by this protein solution on a water surface. After adding so much lactic acid that the *p*H changes gradually from 6·4 to 4, we find that the area remains practically constant from 6·4 to 5·4 and changes suddenly between 5·4 and 4·8 into one having much smaller dimensions. At about *p*H4 it is not much larger than 450×10^{-16} sq. m.

There is a close agreement between the small quantity of lactic acid required to bring about this sudden change of the spreading of the protein molecules, and the lactic acid produced in a single contraction as calculated by A. V. Hill (0·031 mg. per gm. muscle). Much depends on the buffer value of the solution used for the experiments. If we take a very feebly buffered solution of $\frac{1}{1000}$ mol. KH_2PO_4, so little as ± 1·6 c.c. of a tenth molar solution of lactic acid per litre is capable of producing the effect (0·015 mg. per c.c.).

From our experiments with hæmoglobin (*Proc. Roy. Acad. of Sci., Amsterdam*, Dec. 19, 1925) and with other proteins, we are inclined to consider this change in the size of the protein molecule on a water surface under the influence of differences of the *p*H of the solution as a general property of all proteins. We only add here that further increase of the acidity tends to produce the reverse effect, so much so, that the largest surfaces occupied by protein molecules are two to four times larger than those on neutral water. We get on $\frac{1}{5}$ molar hydrochloric acid a film having a thickness of 6·6 to $7{\cdot}5 \times 10^{-8}$ cm. These are considered by us as layers having the thickness of one amino-acid. (Cf. de Nouy, *Journ. Biol. Chemistry*, 64, 1925.)

There exists some evidence indicating that hæmoglobin is orientated at some surface inside a red blood cell in such a way that all the hæmochromogen and iron is placed at the surface. By analogy we suggest that the cystine (or glutathione) part of each protein molecule in muscle is orientated at some external surface, and it is probable that this surface is again the surface of the fibrils, and that the glutathione-lecithin is orientated in opposite places, in order to give the reversible reactions of reduction and oxidation, during muscular contraction and relaxation.

E. GORTER.
F. GRENDEL.

Leyden.

Bigamous Hydrogen—a Protest.

NATURE is always both helpful and challenging and though these be degenerate days, in which the policeman stops duelling, as there is no organised scientific police force, some of us must answer her call and at least constitute ourselves special constables in protection of the liberties of our craft. Scientific son as I am, plus sixty years old, of Frankland, who was the first to enunciate the doctrine of valency, *upon which our entire system of structural chemistry is based*, I have been accustomed always to regard hydrogen as the most single-minded and moral of monogamists. If the story of chemistry, especially that of paraffinic chemistry, mean anything, it is that carbon and hydrogen are mutually satisfied when the carbon atom is married with four hydrogen atoms. The indifference to all external temptation of such unions is most remarkable: whether rightly or wrongly, we have, in consequence, built our entire symbolic edifice upon the assumption that hydrogen is a consistent monad.

I notice that, in the lecture, in honour of Biot, which Prof. Lowry gave recently, in Paris, upon his own work (NATURE, February 20, p. 271), he brought forward certain freak formulæ for tartaric acid, in which hydrogen figures as bigamist. I publicly protested against such aspersion by him of its character, last April, in Brussels: yet the libel is repeated. I may say, he but follows the loose example set by certain Uesanians, especially one E. N. Lewis, a Californian thermodynamiter, who has chosen to disregard the fundamental canons of chemistry—for no obvious reason other than that of indulging in premature speculation upon electrons as the cause of valency: in effect, he has but substituted pairs of dots for the chemist's single bond, thereby deluding himself, apparently, into the belief, that a love-pair of electrons may be hugged by the single hydrogen atom. The way in which the speculation is set out is open to question chemically on almost every page. To quote one case: we are told, that having painted hydrogen as electronegative, as the analogue of fluorine (!), the author had predicted that metallic hydrides would prove to have the character of salts and give hydrogen at the anode. This prediction, we are told, "has been entirely verified in the work of Bardwell (1922), who succeeded in electrolysing a melt containing calcium hydride and obtaining hydrogen at the anode, in amount corresponding to Faraday's Law." No proof has been given, that this hydrogen was not merely displaced by the alkali-metal liberated, during electrolysis, from the fused mixture of alkali-metal chlorides with the hydride used in the experiment. That a writer who belongs to the physical school should be oblivious of such possibility is astounding.

The bigamy of hydrogen is disguised by the blessed word co-ordination—which to-day covers a multitude of wild speculations. Hydrogen, like oxygen, forms co-ordination compounds, says Prof. Lowry. "The real existence of this type of co-ordination can be proved [*sic*] both by crystallographic and by chemical evidence. The X-ray analysis of ice has proved [*sic*] that each atom of hydrogen is surrounded symmetrically by four atoms of hydrogen and that each atom of oxygen is placed symmetrically between two atoms of oxygen."

I heard Sir William Bragg give his paper on ice at the Physical Society and well remember how carefully he pointed out, that the experimental evidence was in no way complete. Do we in the least know the structure of ice? Does position, as determined by X-ray analysis, settle valency? Sodium in salt has six chlorines and chlorine six sodiums surrounding it—are sodium and chlorine to be declared hexads? We are assured that they are not even combined in salt. I would add—we do not believe this, those few of us who are chemists and take some notice of laboratory facts.

As to Prof. Lowry's chemical evidence—

"The simplest chemical evidence for the co-ordination of hydrogen is to be found in potassium hydrofluoride, $KHF_2 \rightleftharpoons \overset{+}{K} + H\overset{-}{F_2}$. A complex anion is here formed by the union of two fluoride-ions and one hydrogen-ion. Since the fluoride-ions are both negatively charged and each ion carries a complete octet of electrons, there can be no direct attraction between them. Since, however, both fluoride-ions have an attraction for the positively charged hydrogen-ion, this may very well act as a link between them as in the formula : $\overset{\cdot\cdot}{\underset{\cdot\cdot}{F}} : H : \overset{\cdot\cdot}{\underset{\cdot\cdot}{F}} :$ or $\overset{-}{F}\ \overset{+}{H}\ \overset{-}{F}$, where the two

fluorines are linked together by a hydrogen nucleus, in just the same way as the oxygen atoms in ice."

From beginning to end this passage is nothing but stark, unsupported and unsupportable assumption and assertion. As it is "off the rails," such speculation, however, in these days of loose thinking, is regarded as something to be worshipped and imitated. "Dragons that are but clay within and brass without" still secure adoration. As of old, they need to be burst asunder with "lumps of seethed pitch and fat and hair."

Prof. Lowry finds difficulty in "the free rotation of the molecule [of tartaric acid] about the single bond between the two central carbon atoms"—hence his device of connecting by means of hydrogen.[1] I suggest that there is no sufficient evidence that such free rotation is usual, if possible. He also speculates as to the character of the dissymmetry of camphor. On this, may I suggest, that the camphor formula which we are accustomed to use is geometrically impossible. I began my career by doubting Kekulé's formula—at its close, I take leave to question the long fashionable substitute and would even assert that the views now current upon the structure of the compounds of the polymethylene and terpene class are often fundamentally unsound and in need of revision.

Prof. Lowry's early optical work is of such perfection, that it is most unfortunate that he, of all chemists, should now indulge in these obscurantisms. The bump of judgment seems to be lacking in the modern school of chemistry—the judicial sense is nowhere to be found. Seemingly, any wild-cat speculation may be indulged in upon paper. Surely, it were time that we returned to serious work in the laboratory and that some effort were made to inculcate the principles of logic into the minds of university students. The entire system of academic teaching is fast becoming suspect: the product is not what we need in practice: it has no power of reasoning upon observation.

HENRY E. ARMSTRONG.

New Experimental Results concerning the Doublet $K\beta_1$.

IN a paper recently published (*Z. f. Phys.* 33, 601, 1925) the present authors came to the conclusion that the new line β' constitutes with the line β_1 the "relativity doublet." In a letter received by the authors, Prof. Sommerfeld points out that, in his opinion, the line β' ought to be considered as a spark line or as a line of unknown origin, since $\Delta\lambda$ according to our data is equal to 4·3 *X.U.*, whilst according to Allison's $\Delta\lambda$ for M_0 is equal to 0·56 *X.U.* The value given by Allison may be verified with the aid of the data for the wave-lengths $L\beta_3$ and $L\beta_4$ which are emitted, when the transition of electrons takes place between the levels M_3 or M_4 and the level L_3, while the transition of electrons from the same levels M_3 and M_4 to the level K gives rise to the lines $K\beta_1$ and $K\beta'$. Accordingly we obtain for $\Delta\nu/R$ from the data for the L series for M_0 the value 1·63, and from Allison's data – 1·27.

The agreement is quite satisfactory. However, we cannot act similarly in our case, as the data for the L series for manganese and the neighbouring elements are not known. Nevertheless, Sommerfeld's point of view may be subjected to another test. In accordance with Wentzel's theory the presence of the spark lines in the part of the spectrum close to the line $K\beta_1$ is due to the fact that the atoms of elements from copper downwards, possessing an uncompleted group M, readily pick up an additional electron and retain it on one of the M levels. Consequently the levels in the corresponding atoms ought to be displaced, and therefore a displacement of the lines of the K series must be expected.

What is the actual process by means of which the catching of an additional electron in the uncompleted group takes place? This may be realised in different ways. For example, the electron striking the anticathode may under favourable conditions penetrate inside the atom and be kept there in the group M, or one of the electrons ejected from the level K may also be stopped in the group M. There are undoubtedly other possible cases, when the electrons may be caught in the uncompleted group. Therefore the existence of atoms of two different kinds seems to be probable: the normal atoms and the atoms charged with an additional electron in the uncompleted M group, by means of various processes.

It is obvious that the atoms in which the additional electron has been ejected from the K level possess the greatest probability of the emission of the line $K\beta'$. If this process actually takes place, we are justified in expecting to find in the absorption spectrum the absorption lines of the wave-lengths equal to $K\beta'$, or close to it. The effect of the absorption may be easily estimated. The relative intensities of the lines of the K series are 100, 50, 35, 17·5, and 15 (Siegbahn; Seljakow and Krasnikow). Hence, it may be stated that the probability of the transition of electrons from the M level to the K level will be roughly 8 per cent. of the probability of the ejection of electrons from the K level. Therefore an electron must be ejected from the K level to one of the M levels not less than 8 times in 100, in other cases being expelled outside the atom. From Glocker's formula it may be calculated that a line in the absorption band, after passing through a sheet of iron or manganese 0·02 mm. thick, will be weakened 1000 times more than any line out of the absorption band under the same conditions. Then one can expect that the lines $K\beta_1$ and $K\beta'$ from manganese and iron, after passing through sheets of manganese and iron 0·02 mm. thick, will suffer weakening to a markedly different degree, or at least that a new absorption line will appear close to the line $K\beta'$.

The experiment gives opposite results: namely, the ratio of the intensities of the lines $K\beta_1$ and $K\beta'$ in the absorption spectrum remains actually the same as in the emission spectrum. There is also no trace of any absorption line in the region we are interested in. Moreover, it was of some interest to know if the line $K\beta'$ would appear at the critical voltage or not. For that purpose the constant voltage was supplied by a Siemens machine of 10,000 V. Thus the voltage did not exceed the critical value for manganese by more than 200-300 volts. Experiments have shown that, in the presence of the line $K\beta_1$, the line $K\beta'$ was always present, and vice versa, in the absence of the first line the second was also absent. The ratio of the intensities remained unaltered and equal to that observed at high voltages.

On the strength of these experiments combined we are led to conclude that the level from which the transition of an electron gives rise to the line $K\beta'$, may be considered as a normal, and hence the combination of the lines $K\beta_1$ and $K\beta'$ is a "relativity doublet." Ray, Ray and Siegbahn (*Phil. Mag.* 1, 1924, and *Phys. Ber.*, 1925) have shown that the law $\Delta\lambda = \text{const.}$ does not hold for the "relativity doublets" in the region of elements, where, according to Bohr, the reconstruction of the inner electronic groups takes

[1] In discussing the anomalous rotatory dispersive power of solution of tartaric acid, in 1913, Dr. E. E. Walker and I suggested alternative formulæ (*J. Soc. Proc.*, 88, 388). We need to know if any change in real acidity take place as the acid changes. Perhaps, as crystal, it may be the dicarboxy-acid and pass over in solution into the monocarboxy-maleic (phthalic) form. Prof. Lowry puts chemical considerations aside.

place. In these regions $\Delta\lambda$ shows a sharp maximum. A similar phenomenon, in an even more striking form, may be expected in the case of $\Delta\lambda$ of the doublet $K\beta_1$, as exactly the same group, which is in a state of reconstruction, gives rise to the lines of the doublet.

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January 18.

The Fluorescence of Mercury Vapour.

IN the course of the study on the band absorption and fluorescence of mercury vapour I have obtained some results, which partly complete but partly contradict former experiments. In the present experiments special care has been taken to maintain the mercury vapour at precisely definite conditions.

Wood (*Proc. Roy. Soc.*, 99, 362, 1921) and Wood and van der Lingen (*Astrophys. Journ.*, 54, 149, 1921) have found that the fluorescence of mercury vapour cannot be excited in quiescent vapour, but only in vapour which is being distilled from the liquid metal at a temperature of 150° C. or more. These authors have arrived at this conclusion as the result of experiments made with several exhausted quartz vessels containing mercury. These vessels were heated and illuminated by an aluminium spark. The fluorescence occurred only in the case when the distillation or a stronger evaporation took place, namely, when a part of the vessel was cooled by an air blast or when the temperature of the entire vessel was rising. If the temperature remained constant for a short time or fell, the effect disappeared altogether.

My first experiments upon this subject were made with a quartz Dewar-flask specially designed for absorption measurements. The flask, carefully cleaned and dried by heating, contained between its walls a certain amount of pure liquid mercury. It was connected with a constantly working mercury-vapour pump. The vessel was heated in an electric oven and the fluorescence excited by a mercury arc lamp or by condensed sparks with electrodes of aluminium, cadmium and zinc. When the temperature of the entire vessel was kept constant at about 155° C. or higher, green fluorescence limited to the beam of the exciting light was definitely observable. With increasing temperature the fluorescence became stronger. When the temperature fell, the fluorescence got gradually fainter and disappeared only at about 155° C., which is not in agreement with Wood's experiments referred to above. Moreover, by a local cooling of the wall of the vessel by means of an air blast or water, the intensity of fluorescence diminished with diminishing vapour density, instead of rising as reported by Wood.

These experiments were, however, not considered convincing, since in the vessel connected with the pumps a distillation, weak as it might be, could possibly take place. In order to avoid this difficulty, some experiments with sealed vessels were performed. Two quartz tubes provided with quartz plates at the ends were used successively. Each tube containing a few drops of mercury was heated in an electric furnace closed by quartz windows; the temperature was measured at three different places by means of thermopiles fastened to the walls of the tube. The fluorescence radiation excited by an aluminium spark was observed visually and photographically. The fluorescence spectrum was taken with a quartz as well as a glass spectrograph. The results obtained in these experiments fully confirm previous ones. The intensity of fluorescence remains unchanged if the entire tube is kept at constant temperature, *i.e.* when distillation and stronger evaporation—as by rising temperature—are avoided. No increase of the fluorescent radiation results from local cooling of the vessel.

The total intensity of the visible fluorescence in saturated mercury vapour as well as that of different bands and lines in the visible and ultra-violet part of the spectrum seems to be, for a given exciting light, a function of the temperature only.

In the spectrum of the fluorescence light of mercury vapour excited by an aluminium spark, besides the bands and lines observed by Wood and van der Lingen (*loc. cit.*), the line 4358 Å.U. was found. This line is well seen on the continuous ground of the visible band. It appears at about 200° C. as a very faint line, gets stronger with rising temperature, and reaches the maximum at 230° C.-270° C., slowly declining at still higher temperatures; at 345° C. it is scarcely seen. In connexion with the line 4358 Å.U. ($2p_2$-$2s$) the behaviour of the line 2537 Å.U. ($1S$-$2p_2$) in the mercury fluorescence spectrum excited by an aluminium spark may be worth mentioning. The latter appears at about 130° C., its intensity grows with the temperature, reaches a maximum value at about 230° C. and then rapidly decreases and vanishes at about 260° C.

Power (*Phys. Rev.*, 26, 761, 1925) and Kapuściński (NATURE, 116, 863, 1925) have observed in the fluorescence spectrum of cadmium vapour excited by some sparks, different from those of cadmium, the line $2p_2$-$2s$ analogous to the mercury line 4358 Å.U. They have observed also two other lines $2p_1$-$2s$ and $2p_3$-$2s$. No trace of the corresponding mercury lines 5461 Å.U. ($2p_1$-$2s$) and 4047 Å.U. ($2p_3$-$2s$) could be found in these experiments.

A detailed account of these experiments will be published elsewhere.

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March 10.

Alternating Intensities in Band Lines.

BANDS in the spectra of neutral and ionised nitrogen show unexplained alternating intensities, and the bands of helium are best interpreted if one assumes that only half the lines are observed, the alternate lines being not merely weak but missing altogether (Mecke, *Zeits. f. Phys.* 26, 227, 1925; 31, 709, 1925). A similar effect seems to be present in oxygen, although the interpretation is less certain. All these molecules are symmetrical, composed of two like atoms. I wish to suggest that the alternations may be connected with the well-known difficulty of assigning the proper period in quantising the rotation of a symmetrical system (Ehrenfest and Tolman, *Phys. Rev.* 24, 287, 1924).

If a dumbbell rotates about the perpendicular bisector of its axis, it returns after half a revolution to a state which cannot be told from the initial state; the place of each end of the dumbbell is taken by the other end. If we wished to quantise the rotation, we might think that the right period for integrating pdq was this half rotation. Then, using p_ϕ, the angular momentum, and ϕ, the azimuth, we should have $\int_0^\pi p_\phi d\phi = nh$, $p_\phi = nh/\pi$. That is, the angular momentum of successive allowed states would differ by h/π, twice the normal amount of $h/2\pi$, and we

might say that every other level was missing. It seems physically most likely that there would be some continuous kind of transition from this case to the case of a non-symmetrical rotator, where all the states are present, and the only possible way would be to have the missing levels gradually appear with increasing dissymmetry of the rotator, first with very small *a priori* probability, and finally assuming their normal *a priori* probability in a sufficiently assymmetrical rotator. The extreme case of symmetry might actually occur in the helium molecule, the intermediate state in the nitrogen.

Such an explanation demands that anomalous intensities should depend on the properties of the states, not of the transitions. On examination of the data one finds that in every case the lines starting or ending at a given rotational state are either all strong or all weak; there are never some strong and some weak lines from a single state. This holds both for the lines belonging to the various branches of a single band originating from a given state, and for lines of different bands which have the state in common. On the basis of this it is plausible that the effect should come from anomalous *a priori* probabilities of the alternate levels.

If the alternating intensities come from symmetrical rotations, some polyatomic molecules containing two or more like atoms might show them. For example, H_2O has the shape of an isosceles triangle, with the O at the apex. If this rotated about the axis passing through the O and bisecting the base perpendicularly, we should have a condition similar to what has been described, so that one rotational degree of freedom should show the effect, not the others. In NH_3, which forms a tetrahedron with the N at an apex and the three hydrogens in an equilateral triangle, a similar rotation would disclose a three-fold symmetry, which might lead to bands with every third line strong. Methane, CH_4, which is presumably a regular tetrahedron of H atoms with the C in the middle, would have a mode of rotation in which it had a two-fold symmetry, and this may explain why in the spectrum of methane two kinds of bands are observed, one with lines spaced about twice as far apart as in the other.

It is a pleasure to acknowledge my indebtedness to Dr. R. S. Mulliken and Prof. E. C. Kemble for very valuable advice and suggestions.

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The Real Meaning of the New Conception of Time.

THE fascinating presidential address of Dr. Jeans to the Royal Astronomical Society, published in NATURE for February 27, with its poetical allusions to children chasing a rainbow over the hills, and to what seems the successive extinction of the shires as one gazes at the country from the windows of an express, must have helped many of us to make fast our hold upon the principles of the general theory of relativity. Yet it is doubtful whether the full implications for the doctrine are generally realised—of such a statement, for example, as "The year 1927 has the same sort of existence as the county of Cornwall." The legitimate inference surely amounts to nothing less momentous than this: that everything that has ever existed or happened, or that ever will exist or happen, in the universe, is immanent in physical space-time or 'ether'; and that what to us participators in the drama being enacted on the space-time stage appears to be the *special* differentiation of the present—of *now*—from the past and the future, is merely an illusion due to our experiencing changes in a certain dimension of the four-dimensional continuum, which imparts the impression of travelling along that dimension and hence the idea of flowing time.

Let us now imagine ourselves, not as pieces in the drama, as actors on the space-time stage from which we can only obtain a limited view of the picture, but as looking on to the stage from an external point of vantage. By the very terms, apparently, of the doctrine of relativity, we should be witnessing the whole evolutionary drama of the physical universe *coexisting* from 'beginning' to 'end,' beholding our ancestors of a thousand years ago with the earth as it then was in the same picture with our actual selves in 1926 and with our descendants of a thousand years hence with the earth as it will then be. The year 1926 would be differentiated in this synoptic view merely in this: that we should recognise from our non-spatial, non-temporal, point of vantage that what in the physical space-time landscape we are calling the present time—our present life—so far from constituting the fullness of life is but an eclipsed view of it.

I submit that, unless words have broken down under the strain to which expositions of relativity have subjected them and have lost their force and vitality, all this is a necessary deduction, signifying to the universe a realism of the grandest kind. Moreover, if space-time ether is thus the scroll, so to speak, upon which everything is recorded, including our own deeds and misdeeds, do we not find a purely *natural* interpretation of certain widely held tenets in religion? The point is, that if the geometry and the mechanics of the world are one, then every *physical* event must fit into the scheme, including our own physical lives and actions. The question of the *nature* of our higher mental or spiritual faculties, operating through matter, is not involved in these implications, but is obviously raised more insistently than ever.

L. C. W. BONACINA.

March 23.

A Planarian Species new to Britain.

SPECIMENS of *Planaria albissima*, Vejd., a Triclad Turbellarian not hitherto known to occur in Britain, have been collected in the environs of Aberystwyth, Wales. My preliminary identification was confirmed by the kindness of Mr. E. Percival, of the University, Leeds. The species was found by Vejdovsky in springbrooks in Bohemia, and Steinmann refers to it as 'rare'; thus the occurrence in the mid-Cardiganshire area is of especial interest. In this area it is very general in distribution; I have found it in rivers and brooks of all types, and at altitudes ranging from practically sea-level to 1250 feet above. Many of the specimens are sexually mature, and asexual reproduction by transverse fission appears to be common.

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DR. CARPENTER has kindly allowed us to examine specimens which were undoubtedly mature *Planaria albissima*, Vejd. On comparing these with drawings of immature specimens taken near Leeds in May and October 1922 and March 1923, and Pately Bridge, we feel convinced that the specimens from Yorkshire belong to this species. So far we have failed to find examples in which the sexual organs are developed.

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The Rugby Wireless Station.

By Dr. W. H. ECCLES, F.R.S.

THE Government wireless station at Rugby, now almost completed, is the only one of its class in the British Empire, and is the most powerful wireless station in the world. It was designed by the Wireless Telegraphy Commission and erected by the Wireless Section of the Engineering Department of the Post Office. During design and erection many new problems arose, partly because thermionic valves had not been used on so large a scale before, and partly because extreme efficiency was imperative in order to meet the Government's demand that the station should communicate with every part of the Empire. Many features of the station are novel and of wide interest.

The station occupies a site one and a half miles long and nearly a mile wide, containing about 900 acres, at 340 feet above sea-level. It has twelve masts, each 820 feet high, spread round the edges of the site a quarter of a mile apart. In the middle of the site are the buildings. The machinery hall is 185 feet long × 47 feet wide × 32 feet high, and contains electrical machinery of total power 800 kilowatts, fed from the public supply. A parallel hall measuring 103 feet × 40 feet × 68 feet contains the thermionic triode valves on the ground-level, the condensers on the next level, and the inductances on a still higher level. There are a number of smaller rooms for auxiliary machinery, together with offices, workshops, and testing rooms.

As a rule the steel lattice masts at big wireless stations are earth-connected at their bases and, in consequence, the oscillatory current in and out of the antenna induces oscillatory current up and down the masts. This induced current diminishes the radiation. To ameliorate this defect, insulated masts have been proposed. In fact, insulated masts have been erected in two or three cases, but after being tried have ultimately been connected to earth. The Commissioners thought these failures with insulated masts were due partly to the large electrical capacity between the foot of the mast and the foundation, and partly to bad insulation. They therefore arranged to erect masts on platforms 16 feet above the ground, and made a search for good insulators of small dielectric loss at high frequency. This work was started at Finsbury Technical College by aid of a grant from the Research Department, was continued with more powerful plant at the Admiralty Signal School, Portsmouth, and was concluded at the Post Office arc station at Northholt. As a result, the Commission selected Norwegian granite for the bulky portion of the insulating foot, and porcelain 'cheeses' for the part requiring the greatest electrical strength. As a mast weighs 180 tons, and as the downward component of stress from the stays amounts to more than 100 tons in a gale, these insulators were put through crushing tests as well as high-frequency insulation tests before being accepted for use. The insulation is designed for a quarter of a million volts; the measured voltage during the test of the station has reached 185,000 volts without causing trouble.

The antenna is of novel construction. The traditional 'flat top aerial' consists of a large number of parallel wires running across horizontal triatics which are slung between pairs of symmetrically placed masts; the antenna at Rugby consists merely of one conductor running round nearly the whole circumference of the site by passing from one mast top to the next. The underlying idea is that the electrical capacity to earth of a conductor round the edge of a horizontal elevated area is little less than that of the whole area—that is to say, the interior area adds little to the capacity. A study of the formation of the radiant field enables one to extend the idea to the emission of energy from an antenna. The results achieved by the Rugby station in recent months justify this departure from established practice. Actually, the conductor running round the edge of the site is a composite one consisting of eight phosphor bronze wires arranged as the generators of a cylinder 12 feet in diameter, of which the axis is a steel rope. The wires are supported by the rope on spiders resembling bicycle wheels 12 feet in diameter, which are threaded at equal intervals upon the rope. This skeleton cylinder has an electrical capacity about equal to that of a solid continuous cylinder 7 feet in diameter. It is supported from the masts by halyards each worked by an electric winch near the bottom of the mast. The winches each possess a slipping device set at 10 tons, so that when in a gale or snowstorm the tension in a halyard reaches this figure, the halyard is automatically paid out until the tension is lessened. Rehoisting is done after the storm. Although there is about three miles of this composite conductor hanging in flat festoons each a quarter mile long at a height of 800 feet between the consecutive masts, the slipping device has saved the aerial from breakdown several times during the heavy weather of the past winter.

The method of supplying the antenna with oscillatory current is new and has been developed entirely within the Wireless Research Section of the Post Office. The source of the oscillations is a tuning-fork of frequency 2000 per second, sustained in vibration by a small triode valve such as is used in broadcast receiving apparatus. The sustaining current is distorted by applying a constant negative potential to the grid, and is magnified by passing through two small triodes in cascade with about 150 volts on the anodes. The eight-fold harmonic, that is to say, the oscillation of frequency 16,000 per second, is selected by resonance in a circuit of that natural frequency. The oscillatory current, still very feeble, is now passed through a three-step amplifier using T30 triodes with 1000 volts on the anodes; and the strengthened oscillations then pass to a 600-watt glass triode with 10,000 volts on the anode. The oscillations now go to the grids of three water-cooled metal-glass triodes, from the anodes of which 30 kilowatts of high-frequency power can be drawn. This power is applied to the grids of fifty-four similar water-cooled triodes, also working in parallel, which deliver about 540 kilowatts to the main high-frequency circuit. The anodes of these triodes are supplied with direct current at 10,000 volts by means of motor generators delivering 1000 to 1500 kilowatts at a voltage variable from 10,000 to 18,000 at will. The thermionic current may exceed 100 amperes.

It will be seen that the magnification of the original harmonic in the tuning-fork circuit is enormous; in fact, if we assume that the harmonic is only a few microwatts to start with, the magnification is of the order of magnitude 10^{11} (one hundred thousand million times). Obviously the screening of each circuit from the more powerful one succeeding it in the chain is of the utmost importance and must be carried out thoroughly.

At Rugby the fork has a frequency of 2000 per second and can be slightly adjusted by the inertia effects of small set screws in the prongs. When the temperature in the fork box alters by 1° C. the frequency of the final oscillations changes from 16,000 to 16,001·5, an amount imperceptible in the ordinary receiving apparatus of wireless telegraphy. The advantages of constant frequency are many; but the principal one is that exceedingly selective receiving apparatus can be employed, and all the refinements of accurate note tuning can be utilised, in order to prevent interference by other wireless stations working on nearly the same wave-length.

The design of the high-frequency circuits has presented many problems. These circuits comprise an inductance coil and condensers forming a closed circuit, which is connected on one hand to the anodes of the bank of fifty-four triodes, and on the other hand excites the antenna by means of mutual inductance.

The condensers must withstand a quarter million volts, must pass a thousand amperes at high frequency, and must not cause appreciable loss of energy. Condensers using thoroughly dry and clean oil would probably be best, as oil has a power factor less than one-twentieth of one per cent.; but, in order to save space, mica condensers were adopted, and these have a power factor less than a quarter of one per cent. They weigh more than ten tons. They are carried on a partial flooring about 20 feet above the ground floor on which the triodes stand.

The high-frequency coils in the closed circuit and in the antenna are made of stranded cable containing 6561 separately insulated copper wires of 36 gauge made up by twisting in threes. The coils are of various sizes; the antenna tuning coil, for example, consists of five flat spirals of eight turns each, the outer turn of each spiral being 15 feet 6 inches in diameter. The total weight of the coils is about 6 tons. They are carried on great beams of fir 20 feet above the level of the condensers, and are flanked by flying galleries along which men can pass for inspecting and adjusting the coils. This isolated position is chosen for the coils because the inductive effects of the large high-frequency currents they carry might lead to great energy losses and even to destructive rises of temperature, if any metallic masses were near. The roof trusses, the beams, the supporting framework of the coils, are all of selected wood. The most suitable wood for this purpose, that is to say, the wood with the smallest dielectric loss at high frequencies, is American white wood—a discovery made after long and close investigation in the Post Office laboratories.

The features above described are only a small selection of the numerous novel details with which the station abounds. But the space available permits of no further descriptions. There is just room for a few remarks upon the performance of the station as judged by observers who happened to be listening in at great distances during the tests of the past few months. For example, Newfoundland reported "signals thundering in"; New York said "signals readable through heavy atmospheric and jamming" and "copyable at 75 words per minute"; Cape Town reported "note good and steady"; in the Red Sea "Rugby effectively drowns all interference"; Java reported "key action excellent, frequency very constant"; Dutch East Indies said "Rugby splendidly received, far more distinct than any other European station." The Commander-in-Chief of the China station stated "all ships report note good, clear and steady." Among other Australian stations, Sydney reported "Rugby was only European station readable through atmospherics." These results, it should be noted, have been obtained with less than the full power available. For up to this date only eight of the twelve masts have been utilised on these telegraphic tests, owing to the other four masts being temporarily set aside for the trans-Atlantic telephony trials. The eight mast aerial will take only about 600 amperes without exceeding a voltage of 200,000, and at this rate only about two-thirds of the possible high-frequency power is being drawn from the triodes. But the complete equipment will doubtless be required to ensure communication at all hours of the twenty-four and under severe conditions.

The Stratigraphical Value of Micro-organisms in Petroleum Exploration.

By HENRY B. MILNER.

DURING the last decade of rapid development of technique of petroleum geology, problems of sub-surface stratigraphical correlation have forced themselves to the front, and have engaged the closest attention of geologists operating principally in late Cretaceous and Tertiary oil-fields all over the world. Formerly, and to some extent now, drillers' recognition and classification of rock-chips collected either from bailer or sample box served as a crude guide to underground conditions, though the limited vocabulary and superficial petrological knowledge of the average driller led to some quaint determinations and technically to still more fanciful structural interpretations. 'Gumbo' and 'shell,' for example, cover a multitude of geological shortcomings, while clay, shale, silt, and sand vary in diagnosis largely according to their degree of wetness when they arrive at the surface; anything productive of white powder to the bit is termed 'chalk,' and so on. Such casual nomenclature and equally casual sampling has been part of the long-established code of the oil-well driller, and sufficed until the advent of a more exacting petroleum geology signified the impending and much-to-be-desired change.

The closer study of productive rocks and sub-surface structures concerned with the preservation of petroleum pools has gradually led to the adoption of

refined methods of differentiating and correlating strata, and of actual zoning within given formations deep down in the earth's crust; to this end the geologist has been thrown back on his first principles for the requisite desiderata and the aid both of palæontological and petrological data invoked. The frequent divorce between surface and sub-surface structures has to a large extent influenced this trend of field-technique, so that to-day no geologist worthy of the name would dream of interpreting his key-structures on the basis of mere lithological comparison and description, and certainly not in terms of drillers' evidence.

There are four principal methods now employed for studying sub-surface deposits from samples; three are direct, namely, micro-palæontological, microscopical (the examination of rock-cuttings under the microscope), and petrographical (correlation by means of 'heavy' mineral residues extracted from the sediments); the indirect method is that based on comparison of chemical analyses of subterranean (often connate) waters peculiar to certain porous formations. Of these methods, micro-palæontological investigations theoretically take precedence, though in practice this is not always substantiated if the necessary organisms are rare or wanting; the other methods, while capable of considerable precision and accuracy in competent hands, can only be regarded as local and confirmatory, though they are none the less valuable on that account. We dismiss them here, however, in favour of the much-debated problem of the value of micro-organisms as indexes not only of formations, but also of the more restricted developments such as oil-sands.

For obvious reasons, the macro-organic content of oil-well samples is seldom preserved, however prolific the rocks may actually be in molluscan or brachiopodan faunas, etc., though the recent introduction of the core-barrel, and particularly the use of the diamond drill, tend to heighten the possibility of whole shells reaching the surface. For the most part, however, samples from wells are obtained in a comminuted state, so that whatever fragile remains may be originally enclosed in the rocks drilled through, these soon succumb to the drastic action of the cutting bit. Therefore only the initially minute organic bodies stand a chance of escaping disintegration, and consequently their presence in any sample is of paramount stratigraphical importance. The micro-organisms which have received most attention in the course of exploratory work for petroleum are the Foraminifera, Bryozoa, Ostracoda, Radiolaria, Diatomacea, in that order of interest and importance; sponge spicules and echinoderm spines have occasionally proved useful 'indicators.'

It will be at once apparent that, quite apart from a special aptitude for palæontological investigation, the study of these micro-organisms constitutes the work of the specialist; accuracy in diagnosis, dependent on an intimate knowledge of the organisms as regards their morphology and variations, precision in assigning species or groups of species to particular stratigraphical horizons, and vision in detecting the subtler steps in the evolutionary chains involved: all these, among others, are the qualifications for this type of research. Specialisation is to-day the essence of progressive palæontology; the tendency to resort to 'species splitting' is a concrete result of this intensive study, of which there exists no finer example than contemporary work on Ammonoidea, an example fast being emulated by those engaged with micro-organisms, especially the Foraminifera. If, in view of much recent criticism, such technical procedure stands in need of independent defence, the work of certain expert palæontologists engaged on micro-palæontological research for a purely commercial end, coupled with the measure of success already realised, surely provides some vindication.

The organised investigation of foraminiferal assemblages as a basis of zonal stratigraphy, particularly as applied to sub-surface exploration for oil, has derived considerable impetus, if it has not actually evolved, from the intensive work of American palæontologists, more especially those in the employ of oil companies operating in the Gulf Coast region of North America. Considering the comparatively short time taken in developing necessary technique and accumulating the data to work on, the results already achieved are as surprising as they are significant. It is not as though the Foraminifera claimed at the outset of this intensive work a long-established reference library: on the contrary, the literature was scanty compared with that of many other fossil faunas, though the study had at least the example of Chapman and the inspiration of Cushman to guide it. In this connexion Dr. Dumble has written of these palæontologists that they "had very little knowledge to start with and had to build up their own methods" . . . while another expert, Miss H. T. Kniker, now states, "Examination of thousands of well samples has shown which species have limited vertical ranges and therefore which forams can be relied on to make correct stratigraphic correlations. We have learned to do this even on single species, and all of our correlations are made in the main on undescribed forms."

On the other hand, Dr. T. W. Vaughan says that it "appears very doubtful if there is a zonal distinction" of value among the Foraminifera for the discrimination of geological horizons. Further, he says, "In any event, 25 per cent. is about the maximum percentage of the smaller Foraminifera to which any stratigraphic significance may be attached, and it is more probable that the significant percentage is between 3 and 12 . . . 88 to 97 per cent. of the fauna . . . does not possess zonal value. . . . From available evidence, similar faunas of small Foraminifera are indicative rather of similarity in ecologic conditions than of identity in age." This has, on the whole, been the attitude of European oil geologists and certain palæontologists, who have not hesitated to criticise Cushman for his "tendency to split species to a much greater degree than has been done by others," to which 'splitting' he attributes a large part of his success in stratigraphic correlations on the basis of Foraminifera.

Such scepticism as exists regarding the correlative value of Foraminifera finds root in the general impression of the wide space and time distribution of these organisms, and is legitimately maintained so long as we view them from the point of view of world-distribution and their general literature. Until recently, in the absence of local terms of reference such as those emanating from the Texas laboratories, a Cretaceous or Tertiary species of Foraminifer, if still living to-day

in the sea, has naturally been regarded as worthless from the zonal or even correlative aspect, and thus has Schuchert sought to explain the critical attitude of Vaughan and others. The whole point of the detailed work, however, is its intensiveness, as is the case with petrographic research under similar conditions, and the fact that local assemblages, rather than precise species, constitute the basis of study; zoning is effected by recognition of slight variations in morphology, ornament, etc., by creating new species or new varieties much as in the case of the ammonites previously cited. The question of percentage of living Foraminifera in any faunule, a point on which Vaughan has laid some stress, is entirely subordinated by the specialists to the question of the actual species present and their manner of combination in any particular faunule. According to Cushman, "the time value of forams . . . is entirely dependent on this splitting (of species), for putting together species which are of short range into one long one would entirely defeat the purpose of close correlation."

Mesozoic and Cainozoic Bryozoa have long been recognised as important indexes of horizon, though in the Gulf Coast oil-field region they are of far less frequent occurrence than the Foraminifera. Schuchert has no doubt whatever regarding their true value for sub-surface correlation, and advocates strongly their use on the basis of Canu and Bassler's classical work. According to Bassler, of the two orders of Bryozoa, namely, Cyclostomata and Cheilostomata, the former has potentially little value in sub-surface work, from the fact that precise diagnosis rests on the preservation of the ovicell, almost an impossibility with oil-well samples. The Cheilostomata, however, can be determined from minute fragments and all characteristics can be ascertained, even though only a few individuals or zoœcia are preserved. They tend to indicate limited time-zones over wide areas, and various structures shown on the zoœcium are significant of depth of water, temperature, nature of ocean bottom and character of marine habitat. Add to this that the calcareous structures are generally highly ornate and variable in that ornament, and the possibility of treating them on the same intensive lines as the Foraminifera is apparent. Canu and Bassler describe 742 forms of North American Early Tertiary Bryozoa in their work, many of which are beautifully illustrated.

Ostracods, as we now realise from the Wealden formations of Great Britain, are potentially valuable as time-indicators, though here again much intensive work has yet to be done before they are fully appreciated. Analysis of well-cuttings from the Gulf Coast region reveals their presence and significance, and Schuchert has directed attention to the highly ornate forms of the valves of these minute crustacea, but the Texan species have yet to be worked out. Ulrich and Bassler have demonstrated their potentiality as guide-fossils to limited portions of certain American palæozoic formations, which research at least forms an adequate basis of future investigation.

In so far as Radiolaria, Diatomacea, sponge spicules and echinid spines are concerned in sub-surface work, at the present time we must regard them in much the same light as petrographers regard sporadically occurring mineral species in oil-well samples: of local and possibly direct differential or confirmatory value. As Schuchert says, "each worker must learn what local dependence can be placed upon these isolated occurrences."

Thus it is clear that while a degree of scepticism regarding the use of micro-organisms in stratigraphical correlation may still be maintained on certain technical grounds, the results so far achieved by the American school are worthy of general attention. It is yet one further example of how much the pure science may owe to one phase of its economic application. Readers are referred to the volumes of the American Association of Petroleum Geologists for 1924 and 1925 for several important papers in connexion with the above, and particularly to Schuchert's excellent summary of the subject in volume 8, 1924, pp. 539-553; these volumes are available for reference in the Science Library at South Kensington.

Sterility and Rejuvenation.

IT has been known for a long time that the sexual activity and characteristics of the individual depend on the presence of the sexual glands in an actively functioning condition. Their removal or atrophy as in old age leads to loss of sexual vigour together with changes in the secondary sex characters which may result in the development of a neutral individual, or even in the assumption of certain of the characteristics of the opposite sex, according to the species studied.

Various methods have been used for supplementing a deficiency in the individual's own secretions, such as grafting glands from another member of the same or an allied species, the injection of extracts of the glands, and in males, the ligature of the duct which conveys the sperm from the testes to the urethra: the latter operation (vasoligation) has been performed on the assumptions that the secretions on which the secondary sex characters depend arise from the interstitial cells of the sex glands, and that ligature of the duct, by causing atrophy of the sperm-producing cells, will allow the interstitial cells to hypertrophy, owing to the increased space and nutriment provided. The return of the secondary sexual characteristics does not imply a return of fertility, since, for the latter, the sex glands themselves must be actively functioning *in situ*: that is, atrophied or diseased glands must be reactivated. Grafting alone, therefore, will not restore fertility, except, perhaps, in the case of the female, unless the animal's own sex glands are also reactivated or rejuvenated by means of the secretions from the graft.

Sterility in the female can be caused not only by atrophy (or removal) of the ovaries, but also by persistence of the corpora lutea. During pregnancy these bodies persist and prevent ovulation, and occasionally this occurs apart from pregnancy as a pathological phenomenon and produces sterility, fertility being restored by their removal. It is of interest, in connexion with recent work on the isolation of an

ovarian hormone, that W. P. Kennedy (*Quart. Journ. Physiol.*, 1925, vol. 15, p. 103) has found that cold saline extracts of fresh frozen or dried corpora lutea, intravenously injected, prevent ovulation in rabbits: the effect persists for several months after a number of injections. Continued injections cause degenerative changes, not only in the ovaries, where the number of Graafian follicles is reduced, these changes being probably specific, in part at any rate, but also in the liver and adrenal glands, where the effect may be due to the injection of toxic foreign proteins, or alternatively to changes in the carbohydrate metabolism produced by the degeneration of the ovaries. Since extracts of ovarian tissue are being used for the production of the opposite effect, namely, the return of fertility and the secondary sexual characteristics, it is obvious that care should be taken to use only glands in which there are no corpora lutea, or from which these bodies have been removed, for the preparation of such extracts.

The main interest of some recent work by Steinach and his collaborators on the ovarian hormone appears to lie in the true reactivation or rejuvenation of the ovaries of senile animals (E. Steinach, H. Heinlein, and B. P. Wiesner, *Akad. d. Wissensch.*, Wien, 1925, No. 19, p. 189). These investigators have injected extracts of ovary and placenta into animals castrated both before and after puberty, and into senile specimens, using the vaginal smear method to follow the return or not of the œstrual cycle. Extracts from either source favour the development of the secondary sexual characteristics, but only those from the ovary arouse the sexual cycle. In all cases the normal condition of the animal is restored. The effects observed are produced by only a few injections in young animals, and occur within a few days in both rats and guinea-pigs. The fertility of stock female rats ceases when they are about eighteen months old, and the sexual cycle vanishes a few months later. Injections now restore their vigour and produce a reappearance of the œstrual cycle, the latter continuing regularly after the injections have been discontinued: in other words, the ovaries are reactivated. The next step should be the application of a purified ovarian extract in human therapeutics.

Most of the work on rejuvenation has been performed on mammals. Crew has turned his attention to birds. He has found (F. A. E. Crew, *Proc. Roy. Soc. Edin.*, 1925, vol. 45, p. 249) that unilateral vasoligation in senile cocks is not accompanied by any rejuvenating effect. The only change observed microscopically in the testes was continuation of the degenerative processes seen to be occurring at the time of the operation in a preparation of a portion of the testis on the side of the ligature removed for histological study. No change was observed in their plumage. On the other hand, this author has been successful in obtaining rejuvenation in birds of both sexes by the administration of dried thyroid (*ibid.* p. 252). The doses given corresponded to 0·2-0·8 mgm. iodine daily. The first effect noted was moulting by all birds, and this was followed by an increased egg production by the females, the eggs being fertilised by the males; none of the former, however, became broody. The plumage of cock-feathered cocks became henny, but that of the hens and of hen-feathered cocks remained almost unchanged. The author considers that these results can be explained on the assumption that the sexual glands exert their influence on the plumage, not directly, but by means of an action upon the thyroid. Thus there are two classes of fowls: those whose thyroid responds to a certain low degree of stimulation from the testes with the production of cock-feathering, and to a higher degree of stimulation from the ovaries with the production of hen-feathering; and those whose thyroid responds to the greater degree to testicular stimulation, the cocks thus being hen-feathered. The difference between the thyroids of the two classes is a genetic one. The administration of thyroid can only produce a marked effect on those birds the thyroid gland of which is not normally fully stimulated, that is, cocks with cock-feathering.

Obituary.

PROF. K. LHOTÁK.

ON January 27 there died in Prague, at the relatively early age of forty-nine years, Dr. Kamil Lhoták, professor of pharmacology and pharmacognosy and director of the institute for the said sciences in the Charles' (Bohemian) University. Prof. Lhoták published many scientific investigations in physiology, in which he had a sound training, in pharmacology and pharmacognosy, but the most prominent are his researches on the active substances of digitalis (digitalin, digitoxin). Lhoták also published the first Bohemian treatise on pharmacognosy (1908); but especially noteworthy is his voluminous "Pharmacology" (1924), including also the theory and art of prescribing.

As a teacher Prof. Lhoták turned his attention to the practical work of students in his laboratory, based on his experience in England. But one of his greatest merits, from the international point of view, is that he gave an impulse to the reprinting of the scientific papers of the Bohemian genius Ian Purkyně (Purkinje), who founded the first physiological research laboratory in Germany, so that his researches, scattered in less accessible journals, could become accessible to the scientific world. They are published by the Bohemian Society of Medicine, together with two volumes of the very interesting correspondence of a many-sided scientist. Prof. Lhoták was not only of a real, deep scientific nature, but also a great connoisseur of painting, music, and the world's literature. He was a member of the Bohemian Royal Society of Science, the Bohemian Academy of Science and Art, the Ministerial Institute for the Examination of Medicinal Matters, and of the State Hygienic Council, etc.

BOHUSLAV BRAUNER.

WE regret to announce the following deaths:

William J. Green, a pioneer in horticultural investigations and for many years horticulturalist at the Ohio Experiment Station, aged seventy-six years.

A. Witz, formerly professor of physics in the Catholic University of Lille, corresponding member of the Paris Academy of Sciences, who was known for his work on thermodynamics and on internal combustion engines, on January 25, aged seventy-seven years.

News and Views.

THE Prime Minister is one of the all too rare administrators who fully appreciate the importance of the part played by science in modern life, and his sympathies in this connexion found expression in the address with which he opened the Optical Convention at South Kensington on April 12. In pointing out the vital rôle of optical science in the everyday life of peace no less than of war, he gave as a homely but arresting illustration the fact that even a glass of beer depends for its satisfactory manufacture on the use of at least three optical instruments—the microscope, the polarimeter, and the refractometer. He added that in the last century British optical work was predominant in the world's industry, but during its closing years the industry was nearly overwhelmed by foreign competition, especially on the part of Germany. In that country optical manufacturers at that time enjoyed three great advantages: (1) a stronger tendency amongst German than among British industrialists to invoke the aid of scientific research; (2) the demand for optical goods created by the existence of a large standing army; and (3) a protective tariff. At the end of the War, which demonstrated the danger of allowing this key industry to atrophy, the Government of the day decided that its fate must no longer be left to chance, and introduced the two remedies of 'safe-guarding' and a money grant allotted through the Department of Scientific and Industrial Research. Since the War, several new difficulties have had to be faced by the optical industry—a general depression of trade, large surplus stocks of optical material, and the abnormal rates of exchange which made foreign competition acute. In the Prime Minister's view, the Exhibition indicated that in spite of these difficulties the quality of British optical manufactures has again been raised to the highest level of achievement.

AMONG the varied topics touched upon by the Astronomer Royal in his presidential address to the Optical Convention, delivered on April 12, not the least interesting was the part which British optical designers and manufacturers have played in providing the instruments with which outstanding discoveries have been made in the history of astronomy. Thus the fact that cross-wires could be inserted in the Kepler telescope was first noted by Gascoigne; the possibility of making achromatic combinations of crown and flint glass was discovered by Chester Moore, and re-discovered and published by Dollond, and for a time the manufacture of these was an English monopoly; but in the earlier part of the nineteenth century the industry was crushed by an exorbitant tax on flint glass. In due course this was removed, however, and in the second half of the century British opticians played their part in the provision of objectives of increasing size. A 40-inch refracting telescope is now being constructed in England for Russia. As regards reflecting telescopes, the art of grinding and polishing mirrors was due to Newton, and the parabolic mirror to Hadley. The great development of the reflecting telescope in the second half of the eighteenth century was the work of Sir William Herschel. The silvered mirror was a German invention, but was first constructed on a large scale by Dr. Common and Sir Howard Grubb. Good work by British firms was also described in connexion with astronomical photography: for example, an English amateur, Franklin Adams, with a lens made by H. D. Taylor, has photographed the whole sky in 206 exposures. As regards instruments for stellar spectrography, it is of interest to learn that the échelon spectroscope is made only by a British firm.

THE breakdown in the negotiations between Mr. John D. Rockefeller and the Egyptian Government over the terms of the proposed gift by the former of a sum of ten million dollars for the construction and maintenance of a new archæological museum and institute at Cairo does not come altogether as a surprise. For some time past the Egyptian public and its representatives have tended to become increasingly assertive of their prerogatives in relation to foreigners engaged in archæological research within their jurisdiction. The official action which interrupted the excavation of the tomb of Tut-ank-Amen, merely gave effect to a widespread and growing feeling among the Egyptians which was brought to a head by methods of securing publicity which many archæologists and others felt to be ill-judged. Undoubtedly among the extremists some would have wished to see Egyptian archæology for the Egyptians as the ruling principle.

IN the present case it has been stated that difficulty has arisen over the composition of the committee in whom control of the museum and institute is to be vested for a period of thirty years. While Mr. Rockefeller has explained that this provision is to allow time for a generation of trained Egyptians to grow up who would be fully qualified to take over the custody of the national treasures, the Egyptian Government objects to management by a committee on which two Englishmen, two Frenchmen, and two Americans would sit with two Egyptians only, even though one of these should be the chairman of the committee. Apart from the desire of every archæologist that the advantage to scientific research which must follow from Mr. Rockefeller's munificent gift should not be endangered, the importance of Egypt in the history of civilisation gives it a position which is unique and of universal moment. Its records and cultures justly demand the highest skill in investigation, in interpretation, and in preservation. To take measures to secure such skill is a duty incumbent on those in authority, which transcends the bounds of nationality.

THE airship *Norge* arrived at Pulham on April 11 from Rome, en route for Oslo, where a mooring mast is available, and Spitsbergen, where a mast and partial shelter are being prepared. From Spitsbergen an attempt will be made to transnavigate the north polar regions. The *Norge* was built to the designs of Col. Nobile, in the Italian State Airship Factory at Rome. It is a semi-rigid airship of displacement 20 tonnes, length 106 m., height 26 m., width 9·5 m.,

power 3 × 190 kw., maximum speed 100 km. per hour. The direct distance from Rome to Pulham is about 1250 km., but the actual course through the Valley of the Garonne, between the Pyrenees and the extensive highlands of Southern France was about 2250. Thanks to favourable meteorological information, the airship did not re-fuel at Rochefort on the west coast of France, but continued the flight to Pulham, covering the 2250 km. without stop in 30 hours, giving an average speed of 75 km. per hour, a very satisfactory performance. The co-latitudes of the most northerly points of Spitsbergen and Alaska are about 10° and 20°, and the polar distances are therefore about 1000 km. and 2000 km. respectively. The transnavigation of 3000 km. of polar wastes without the possibility of intermediate landing and without meteorological information seems a bold undertaking; but it is not in the nature of pioneers to count risks in relation to the results obtainable, and it may be hoped that a combination of favourable circumstances will bring the maximum possible success to these adventurers in the most modern style.

ON April 8 Mr. S. Mavor read a valuable paper to the Institution of Electrical Engineers on the applications of machinery at the coal face. He pointed out that, in mining, labour accounts for 75 per cent. of the total costs of production. Many palliatives of the existing situation have been suggested, but, apart from increasing the number of working hours, the only way to effect a substantial increase of the output per man and a consequent reduction of costs is the systematic application of labour-saving machinery. In England the proportion of machine-cut coal to the total output is 14 per cent., but in Scotland the proportion is 47 per cent. The difference is due partly to economic pressure compelling a reduction in the costs of production, but mainly to the fact that electricity can be applied safely at the coal face in most of the Scottish mines. In Scotland more than 93 per cent. of the coal cutters in use are electric, the remainder being compressed air machines.

A VERY important factor in the rapid extension of machine mining in the United States is that the comparative freedom from gas in the mines renders electricity permissible. In Scotland, however, the rate of increase during recent years in the proportion of machine-mined coal has been even greater than in the United States. Mr. Mavor advocates intensive mining on the unit system. The methods must be standardised and a daily cycle of operations established, so that the work becomes comparable to repetitive processes in workshops. The principles which have so greatly increased the productivity of labour in other industries should be applied to mining organisation and operations. The output per underground worker is too low, therefore too many men are in the industry, and hence wages are low and costs are high. By mechanical and electrical aids to production the output per man can be increased, wages and the status of the miner can be raised, and the cost and price of coal can be reduced.

THE intimation that Mr. Alan A. Campbell Swinton is retiring from the electrical and general consulting engineering practice that he has carried on for the past thirty-seven years at 66 Victoria Street, Westminster, will not come as a surprise to those who are acquainted with his activities in other directions. Last year his failing health caused grave anxiety to his friends, and they will be glad to know that it is now restored sufficiently to enable him to continue his special consulting work and his electrical and engineering directorships. His address, as formerly, will be 40 Chester Square, S.W.1. There are few men who have maintained touch for so long and so intimately with so many learned societies, technical institutions, social clubs, and commercial administrations. It is of interest to recall that Mr. Swinton was one of the earliest workers with X-rays; and we believe that the X-ray photograph of a human hand, published in NATURE of January 23, 1895, with an article by Mr. Swinton and a translation of Prof. Röntgen's paper "On a New Kind of Rays," was the first radiograph reproduced in Great Britain. The lecture which Mr. Swinton gave at the Royal Society of Arts a few months ago upon persons of distinction in the world of science and engineering, will always be remembered as a valuable and amusing contribution to the history of the scientific men of his time. His own part in the advance of electrical science and electrical industry, as a liaison officer between scientific, engineering, and commercial enterprises, has been of considerable value, and good wishes from all these centres of progress will go with him in the comparatively restricted activities which he now contemplates.

THE problem of stage lighting, discussed at the meeting of the Illuminating Engineering Society on March 29, is one in which artistic perceptions and knowledge of scientific principles need to be carefully blended. Mr. H. Lester Groom, in an introductory paper, reviewed recent progress in the design of stage-lighting apparatus, referring particularly to the 'cyclorama' as one of the most important developments during recent years. By its aid the stage is provided with an artificial horizon, and clouds, storms and atmospheric phenomena can be imitated with a fidelity unrealisable in the past. It was mentioned that, on the Continent, cinema theatres are now beginning to introduce such apparatus as an auxiliary to the showing of films, and it forms a valuable aid, provided the dimensions of the stage enable a proper perspective to be obtained. The consumption of energy for the complete apparatus ranges from about 20 to 100 kw. according to the size of the theatre. Other interesting applications of scientific principles include the use of changing coloured light to bring about apparent transformations in scenery, the applications of ultra-violet light impinging on dresses of dancers impregnated with fluorescent solutions, and the possibility of projecting luminous stage scenery instead of using painted canvas. Recently devised apparatus enables the colours to be blended and graduated at will, and any design gradually built up to suit the scenic artist; in

addition, the method has the advantage that the contrasts are more vivid—in the same manner as occurs when a lantern slide is substituted for a photographic print. The discussion raised a number of interesting points, such as the desirability of promoting highly diffused illumination and 'soft' shadows, and the difference in the sharpness of definition of objects illuminated respectively by red and blue light.

IN view of criticisms levelled against the proposed expenditure of the Boxer indemnity on Chinese education, Mr. Harold Balme's account of educational progress in China under the Republic, in the *Nineteenth Century and After* for April, is opportune. Under the old regime the enthusiasm for learning which was characteristic of the Chinese, or at least such of them as had the leisure for its pursuit, was accompanied by a supreme contempt for the knowledge of the foreigner. Owing to several factors, and particularly to the influence of missionary schools and colleges and of such Chinese as have been trained abroad, this spirit has now disappeared. The old private school with its purely literary training was abolished in 1902. Its place has been taken by 200,000 Government and private schools of all grades, offering modern courses to some seven million scholars of both sexes, and staffed with teachers mostly trained along modern lines. Since 1912, when the new Republican Government reformed the educational system, education has gone forward by leaps and bounds. The difficulty of securing trained teachers has been one of the gravest of a number of causes of difficulty; but this is now being met by the output from the training colleges, of which Mr. Balme speaks highly from personal knowledge. Associations for the reform of education have been formed throughout the country, of which the most important is the National Association for the Advancement of Education. It is significant that these associations have welcomed and invited expert advice from outside China—a fact which augurs well for any system of co-operation between West and East on a permanent basis which it may be possible to set up in the future.

WHAT is described as the greatest live game collecting expedition ever attempted is being sent out by the Smithsonian Institution, in co-operation with Mr. Walter P. Chrysler, the motor car manufacturer, to British East Africa, for the primary purpose of obtaining living examples of African big game and other animals for exhibition in the National Zoological Park at Washington. The expedition will be under the leadership of Dr. William M. Mann, the Superintendent of the National Zoological Park; and other members of the party include Mr. Arthur Loveridge, of the Museum of Comparative Zoology at Harvard, who, as a former game warden in Tanganyika Territory for eight years, possesses a peculiarly intimate knowledge of the country; Mr. S. Haweis, and Mr. Frank Lowe, one of the keepers at the Washington Zoo, as well as artists, photographers, and a kinematograph operator. Among the animals to be sought for are giraffe, black rhinoceros, sable antelope, topi, hartebeest, zebra, guereza monkey, Syke's monkey, lion, eland, and other antelopes and gazelles. Birds and reptiles will also be collected. Opportunity will be taken to make as extensive collections as possible, for scientific purposes, of the general fauna of the country, and valuable results from this point of view may be expected. The expedition will land at Dar-es-Salaam and proceed inland to Tanganyika Territory, and it is expected that at least five or six months will be spent in the field. Memories of the results obtained by the Roosevelt Expedition to Africa in 1909, sent out also under the auspices of the Smithsonian Institution, raise expectations of equally successful results from the Smithsonian-Chrysler Expedition.

IN February last it was decided that an address should be presented to Sir Howard Grubb in recognition of his skill and long-continued labours in the production of large objectives for astronomical instruments. Many of these are now famous: they include the 28-in. at the Royal Observatory, Greenwich, the 27-in. at Vienna, the 26·5-in. at the Union Observatory, Johannesburg, the 26-in. at Greenwich, the 24-in. at Cape of Good Hope and also at Oxford, and eight (of the eighteen required) 13-in. objectives for the Astrographic Catalogue and Chart, besides the reflectors—the 40-in. at Simeis, the 24-in. at Edinburgh, and the 24-in. at Daramona. Accordingly an address was drawn up congratulating Sir Howard Grubb on the approach of his eighty-second birthday, in which the signatories recalled "with admiration his devoted application of his resourcefulness and ingenuity to the development of the instrumental equipment of astronomers through more than sixty years." Especial reference was made to the service which Sir Howard Grubb's firm has rendered to science "in the provision of suitable object glasses, and of the refined clockwork needed for the accurate movement of the telescopes," in order to undertake the photographic survey of the heavens. The address was signed by the Astronomer-Royal and the leading representatives of astronomy and astrophysics in Great Britain.

THE council of the Royal Anthropological Institute has awarded the Huxley Memorial Medal to Dr. Aleš Hrdlička of the Smithsonian Institution, Washington, and has invited him to deliver the Huxley Memorial Lecture of the Institute for 1927. This invitation Dr. Hrdlička has now accepted. Of the wisdom of the award there can be no two opinions. Dr. Hrdlička has a world-wide reputation as one of the foremost physical anthropologists of the day, and is one of the outstanding men of science in America. His researches on the origin of the American Indian and on the antiquity of man in America are mainly responsible for the present position of our knowledge relating to these important problems, and it is due to his critical and careful examination of the evidence bearing upon the age of the ancient human remains found in America that the extravagant claims for high antiquity which have been put forward from time to time have been demolished. During last year Dr. Hrdlička visited the principal sites in India, Java, Australia, and South Africa on which remains

of early man have been discovered, and gave an account of the results of his tour to the Royal Anthropological Institute while passing through England on his return to the United States.

MR. F. W. LANCHESTER has been awarded the gold medal of the Royal Aeronautical Society in recognition of his pioneer work in aviation, and has also been elected an honorary member of the Society.

PROF. CHARLES FABRY, professor of physics at the Sorbonne, Paris, will deliver the eleventh Guthrie Lecture of the Physical Society of London on April 23. The title of the lecture will be "The Absorption of Radiation by the Upper Atmosphere."

SIR JOHN ROSE BRADFORD, formerly professor of medicine at University College, London, has been elected president of the Royal College of Physicians, in succession to Sir Humphry Rolleston, who retires after four years of office.

THE sixteenth annual May Lecture of the Institute of Metals will be delivered on May 19 at the Institution of Mechanical Engineers, Storey's Gate, Westminster, London, S.W.1, by Prof. H. C. H. Carpenter, professor of metallurgy at the Imperial College of Science and Technology, South Kensington, who will take as his subject, "Single Metallic Crystals and their Properties."

AMONG the changes in place-names announced in recent years by the Soviet Government we notice, in the *Weekly News Bulletin*, No. 34, of the U.S.S.R. Society of Cultural Relations with Foreign Countries, that Nicholas Land, which was discovered in 1913 to the north of Cape Chelyuskin, in future is to be known as Northern Land and the adjoining Tsarevich Alexis Island is to be Little Taimir.

THE Council of the Iron and Steel Institute has awarded the Bessemer Gold Medal for 1926 of the Institute to Sir Hugh Bell, Bart. The medal, the award of which is made in recognition of outstanding services in the advancement of the art of the manufacture of iron and steel, will be presented to Sir Hugh Bell at the annual meeting of the Institute on May 6, by the incoming president, Sir W. Peter Rylands.

IT is stated in *Science* that the John Fritz Medal Board of Award, representing the American Society of Civil Engineers, the American Institute of Mining and Metallurgical Engineers, the American Society of Mechanical Engineers, and the American Institute of Electrical Engineers, has presented the John Fritz gold medal to Edward Dean Adams, "engineer, financier, scientist, whose vision, courage and industry made possible at Niagara Falls the birth of hydro-electric power."

THE annual meeting of the British Science Guild will be held at the Mansion House, London, E.C.4, on April 29, at 4.30 P.M., under the presidency of Lord Askwith. Addresses will be delivered by Sir Richard Redmayne on the future of the coal mining industry; by Dr. E. F. Armstrong, managing director of the British Dyestuffs Corporation, Ltd., on dyestuffs; and by Capt. P. P. Eckersley, chief engineer of the British Broadcasting Company, on broadcasting and the electrical industry in Great Britain.

THE Academy of Natural Sciences of Philadelphia announces that the 1926 Hayden Memorial Geological Award will be made to Dr. William Berryman Scott, professor of geology at Princeton University, in recognition of his "many researches and publications in the field of vertebrate paleontology." The award, which consists of a gold medal, is made once in three years, and was founded as a recognition of pre-eminent work by "publication, exploration, discovery, or research in the sciences of geology and paleontology."

WE have received from the British Museum (Natural History), South Kensington, London, S.W.7, some further series of picture post-cards which are admirably executed by the three-colour process. Set E. 39 portrays *Papilio dardanus* and its four remarkable forms of the female butterfly: E. 40 illustrates some exotic moths, E. 41 exotic beetles, and E. 39 some of the more interesting and striking Hymenoptera. Each of these sets comprises five cards and is priced at 1*s*. The cards are of very definite educational value, being prepared under the supervision of specialists in the subjects dealt with, who are also responsible for the explanatory letterpress. A great variety of other subjects are described and illustrated in the same manner, and the cards are obtainable from the Museum or from London booksellers.

HIS Majesty the King has approved the following awards of the Royal Geographical Society:—*Founder's Medal*: to Lieut.-Col. E. F. Norton for his distinguished leadership of the Mount Everest Expedition 1924 and his ascent to 28,100 feet; *Patron's Medal*: to Sir Edgeworth David for his work on the Funafuti atoll, and with Sir Ernest Shackleton's Antarctic Expedition of 1907-9, as leader of the first ascent of Mount Erebus and of the party which first visited the South Magnetic Pole. The Council has made the following awards:—*Victoria Medal*: to Dr. John Ball for his desert surveys and memoirs on the geography of Egypt; *Murchison Grant*: to Mr. Frank Debenham for his contributions to the scientific exploration of the Antarctic; *Back Grant*: to Afraz Gul for his surveys in Central Asia and Hunza; *Cuthbert Peek Grant*: to Major Kenneth Mason to assist his further exploration of the Himalaya; *Gill Memorial*: to Dr. H. Gordon Thompson for his journey on the Tibetan and Mongolian borders of China with Brig.-General George Pereira.

THE fifth report of the Executive Committee of the Universities' Library for Central Europe, covering the period April 1924 to March 1925, shows that there is a demand in every country in Europe for English books and a desire for information as to English culture and ideals. The Committee has striven with some success to satisfy the calls which have been made, but it is evident that it is hampered to some extent by want of funds. The most valuable service performed by this Committee appears to be in filling

gaps in serials occasioned by the breakdown of exchanges during the War period and the satisfaction of definitely ascertained wants—but a certain amount of forwarding and reciprocal exchange work was also undertaken. We read, for example, of 400 volumes of German classics being forwarded to Berlin. During the year under review gifts of books and periodicals valued at 1500*l.* were received by the Committee and sent abroad. The work of this Committee deserves increased support.

A USEFUL list of 138 atlases, maps, and books of geographical interest has just reached us from Mr. F. Edwards, 83A High Street, Marylebone, W.1. Its number is 480, and it supplements Catalogue 475—"Old Time Cartography." It can be obtained free upon application to the publisher.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—Two laboratory assistants in the biochemical department of the Low Temperature Research Station, Cambridge—The Superintendent of the Station, Downing Street, Cambridge (April 24). An assistant bacteriologist at Queen Mary's Hospital for Children, Carshalton, for research work on acute rheumatism in children—The Clerk, Metropolitan Asylums Board, Victoria Embankment, E.C.4 (April 26). A principal of the South Staffordshire Mining Schools—The Director of Education, County Education Offices, Stafford (April 27). An assistant inspector under the Ministry of Agriculture and Fisheries, in connexion with agricultural and horticultural education and research—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W.1 (May 3). A lecturer in charge of the Economics and Commerce Department of University College, Southampton, and an assistant lecturer in geography in the same institution—The Registrar (May 3). A probationer naturalist and a technical assistant under the Fishery Board for Scotland—The Secretary, Fishery Board for Scotland, 101 George Street, Edinburgh (May 9). A male assistant superintendent of traffic (Class II.) in the London Telephone Service, and a male assistant traffic superintendent in the Provinces, G.P.O.—The Secretary, Civil Service Commission, Burlington Gardens, W.1 (June 2). A director of the Amani Institute, Tanganyika Territory—The Private Secretary (Appointments), Colonial Office, 38 Old Queen Street, S.W.1 (August 1). Two temporary research assistants under the Foot-and-Mouth Disease Research Committee—The Secretary, Foot-and-Mouth Disease Research Committee, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W 1. A director of research for the Linen Industry Research Association—The Secretary, Research Institute, Lambeg, Belfast.

Our Astronomical Column.

ENSOR'S COMET.—Mr. S. Seliwanow, of the Observatory of the Russian Society Mirovédénié, Leningrad, writes to say that the Society organised an ascent in a captive balloon on the night of February 22-23 in which he took part. He passed low clouds at a height of 350 metres; above them the air was clear. Using a powerful binocular, the comet was located after a twenty minutes' search south-west of ϵ Equulei. It appeared as a dim indistinct spot 8′ to 10′ in diameter, of about the fifth magnitude. The time was $3^h\ 22^m$ U.T., the height 700 metres. A faint tail, 20′ long, was suspected. A later ascent by G. A. Langé and B. W. Okunev confirmed these results.

Search was made with a 175 mm. refractor on March 6 and 7 without result.

Dr. W. H. Steavenson notes that these results, combined with his own, appear to fix the collapse of the comet's light as having occurred between February 23 and 28.

A slide from the Bergedorf photograph of March 16 was shown at the meeting of the Royal Astronomical Society on April 9. It showed a tail 30′ in length, forking into two branches about 20′ from its eastern extremity. The tail made an angle of 80° with the radius vector.

BRILLIANT SOLAR OUTBURST.—At the meeting of the Royal Astronomical Society on April 9, Mr. Evershed showed some spectroheliograms of the sun taken by Dr. Royds at Kodaikanal on Feb. 22, which indicated that an extremely brilliant chromospheric outburst occurred over a sunspot during the course of the observations. It was photographed both in hydrogen and calcium light. Some similar outbursts in the past were referred to, including that observed by Hodgson and Carrington in 1859, another observed by Young in 1872, and one observed by Mr. Evershed in Kashmer. Mr. Evershed suggested that the outburst resembled on a small scale those that occurred in novæ. There was the same reversal of lines, and the same indication of rapid radial motion. On some of the occasions quoted, magnetic fluctuations have been observed simultaneously with the outburst; he suggested that the magnetic traces should be examined on this occasion. Mr. Newton noted that there was a large magnetic disturbance on February 23, and promised to examine the record of the preceding day.

MEASURES OF THE SUN'S DIAMETER.—The facts that the curve of sunspot activity bears some resemblance to the Cepheid light curve, and that a widely held explanation of the variability of the latter stars is that their diameters pulsate, render it quite a pertinent inquiry whether any similar pulsation can be detected in the sun's diameter. G. Armellini, in *Astr. Nach.*, No. 5419, describes a research of this kind made at the Campidoglio Observatory, Rome, from 1877 to 1900, some six hundred measures being made each year by three different observers. The method of projection on a white screen was employed. The mean horizontal semidiameter of the sun for the whole series is 961″·18, agreeing with that used for the bright limb in the "Nautical Almanac" (but not with that of Auwers, corrected for irradiation, which is 959″·63). The measures when plotted by annual means lie on a sinuous curve with maxima in 1878 (961″·46) and 1891 (961″·76), minima in 1886 (961″·00), and 1897 (960″·70). The fluctuations are large enough to suggest a real change, but the period dealt with is too short to assert with confidence that it is connected with the sunspot variation. Results for the years following 1900 are promised shortly.

Research Items.

THE STONE AGE OF CEYLON.—An important study of the stone implements which have been found in Ceylon, and of the evidence for their antiquity, by Dr. Fritz Sarasin, appears in Nos. 1-2 of vol. 36 of *L'Anthropologie*. As in the case of other finds in subtropical or tropical Asia, owing to the absence of such indications of age as is afforded by glaciation in western Europe, or the presence of extinct fauna, it is difficult to correlate the implements with the recognised phases of the Stone Age in Europe. Of the views that have been put forward by various writers, that which assigns these implements to the Neolithic period is scarcely likely to be correct. It is precluded by the absence of polished implements, of pottery, and above all of the typical neolithic axe, both from the implementiferous strata in the caves which have been explored, and from the similar surface finds. The author's view is that they must be assigned to the Upper Palæolithic. This is confirmed by the results of a recent visit to Ceylon in 1924 to test the conclusions put forward by Mr. Wayland that he had discovered implements belonging to the Lower Palæolithic. The resemblance of certain types to Early Palæolithic implements is accounted for in part by the material employed, which does not lend itself to the manufacture of the smaller and more delicate type; in part by a sporadic survival of a ruder form in contemporary use with the later type, as commonly happens; and in some cases by the misinterpretation of nuclei as implements. Further, only isolated examples of the so-called early types are found instead of series of implements which could be referred as a whole to any one of the Early Palæolithic cultures, as should be the case had they really belonged to such a culture.

POTTERY STYLES AND PERIODS IN PERU.—Mr. A. L. Kroeber describes in vol. 21, pts. 5 and 6, of the *University of California Publications in American Archæology and Ethnology*, two more of the collections of Peruvian pottery made by Dr. Uhle and now in the University Museum—one from Moche and one from Supe. These Dr. Uhle himself assigned to four periods at Moche: Proto-Chimu, red and white ware associated with long skulls; Tiahuanaco and Epigonal; post-Tiahuanaco, black ware and, possibly separate, red, white, and black ware; and Chimu, black ware with Inca admixture. In the course of his analysis of this material to test Uhle's conclusions, Mr. Kroeber discusses the question of how far distinct style is necessarily proof of distinct period in time—a question of considerable general interest. He finds that, so far as pre-Hispanic America is concerned, there is abundant evidence that distinct styles did repeatedly co-exist. Thus at Pachacamac, Uhle's Tiahuanaco and Epigonal, though valid stylistically, are found in association, and good and debased Tiahuanaco are found in the same household. As regards periods traceable through a large part of Peru, not more than four are at present recognisable. These are: pre-Tiahuanaco, including proto-Nazca, proto-Chimu, early Ancon (shell-mound), and probably Supe shell-mound styles, advanced in development in northern, and backward in central Peru; Tiahuanaco and Tiahuanacoid (Epigonal); pre-Inca era, a period, like the first, of local styles, some vigorous and original, others degenerate, though no sharp line can be drawn between this and the Tiahuanaco styles; and lastly, the Inca era, which includes not only classical Inca styles, but modified and mixed Inca styles such as late Chimu. All known styles of Peruvian pottery can be fitted into these eras.

EUROPEAN CORN BORER IN THE UNITED STATES.—Among the numerous bulletins and papers issued on the European corn borer in America, the most recent that has come to hand is by Mr. R. H. Pettit. He writes on the status of this insect in Michigan in *Circ. Bull. 70 Agri. Expt. Station, Michigan State College of Agriculture* (Nov. 1925). This State is threatened by the increase of the corn borer, like so many other parts of the United States. No measure in the light of existing knowledge can prevent the pest from eventually establishing itself wherever corn is grown. Probably the worst infestation up to the present time has occurred in Ontario, where in some cases fields have shown a total loss. The author lays stress upon the value of State quarantine and the adoption of certain defined farm practices as affording the only possible means of restraining the insect, as it is too early to hope for results from parasite introductions.

HIBERNATION OF A SUCCINEA.—Dr. S. L. Hora (*Records Indian Mus.*, 27, part v., Sept. 1925) gives a short account of the hibernation of a Succineid mollusc, *Succinea arboricola*. Living specimens were found at the end of August 1924 adhering very tenaciously to the bark of mango trees, and in form and coloration resembled wart-like outgrowths of the bark. Dead vegetable growth, chiefly of lichens, covered the bark and also the shells, which were very difficult to see, and in fact were first discovered by mere chance. When a specimen was forcibly detached a scar remained on the bark and a thin white epiphragm was found to cover the aperture of the shell. On removing the epiphragm the animal was seen to be in a comatose condition. Other specimens were found on the under surface of leaves of the mango; they were sluggish, but their shells were not covered with vegetable growth. The peculiarity about this species is that it is found in a comatose condition during the rainy season, when most of its relatives are known to be active. The rainy season at Lonavla (in the Western Ghats), where the specimens were collected, is very long and the annual rainfall about 400 inches, and the author suggests that the peculiar habit of hibernation during the rains is a device for protecting the animal from being washed down by heavy rains. Dr. H. S. Rao gives an account of the anatomy of this new species.

THE VREDEFORT GRANITE.—In the *Trans. Geol. Soc. S. Africa* (vol. 28, 1925, p. 135), Dr. A. L. Hall brings forward convincing evidence to show that the Vredefort granite is not intrusive into the Witwatersrand system, and is therefore not responsible for its metamorphism. The granite bears no resemblance to the Buschveld granite, but is more like the 'Older' granite of South Africa. Its outcrop covers a circular area twenty-five miles in diameter, and surrounding it is a concentric girdle of amygdaloidal lavas now converted into a granulite. Above the basal amygdaloid are the Lower Witwatersrand formations, which have also become intensely metamorphosed. Two causes in succession appear to be responsible for the metamorphism: (*a*) regional static metamorphism, due to the load of overlying sediments, and aided by the additional pressure generated during the updoming of the area; and (*b*) local thermal metamorphism, eccentric to the Vredefort granite, and due to the intrusion of a younger, still largely concealed,

igneous body, the presence of which is indicated by several exposed bosses of alkali granite. The second cause has reinforced the effects of the first by producing coarser crystallinity of the rocks in general, and increased abundance of some of the typical metamorphic minerals.

PLATINUM IN SOUTHERN RHODESIA.—The recent discovery of platinum in the Transvaal has stimulated interest in the possibility of finding payable platinum deposits in the norite of the so-called Great Dyke of Southern Rhodesia. Nearly twenty years ago, Mr. F. P. Mennell suggested that this enormous intrusion appeared to form a promising belt of country to prospect for platinum, and his prophecy has now been justified by the discovery of the metal in three large areas. A publication of the Southern Rhodesia Geological Survey (Short Report, No. 19, March 1926) by Mr. B. Lightfoot is devoted to the description of these areas and the associated rocks. The intrusion is composed essentially of the four minerals labradorite, augite, enstatite, and olivine, producing by their possible combinations fifteen different types of rocks. The platinum occurs, as in the Transvaal, in bands of pyroxene-rich norite containing disseminated sulphides and overlain by felspar-rich norite. The intrusion appears to be a greatly elongated laccolith, possibly fed by a true dyke below. Pronounced joint planes dip towards the 'Dyke' in many localities along its course, suggesting that the invaded granite lies beneath the flanks of the intrusion on both sides. The actual structure has long been a puzzle to geologists, and as it has now become of economic as well as of scientific importance, since it enters into the question of the future development of both chromium and platinum ores, it is likely soon to be further elucidated as prospecting work proceeds.

ARCTIC ICE IN 1925.—The Danish Meteorological Institute has published its annual report on the state of the ice in the Arctic seas. As usual, the data are most numerous from the Barents Sea, Spitsbergen, the west coasts of Greenland and Alaska, but in 1925 a good deal of information was available from the east coast of Greenland. From the Beaufort Sea and the coast of Siberia practically no data came to hand. The most notable feature of the year was the unusually small amount of ice observed in practically all the Arctic seas that were visited. During the summer, the Barents Sea was free from ice and the Kara Sea was remarkably open. Spitsbergen waters were very clear, and during August there was open water round practically the whole of the group. Franz Josef Land, as usual, was more or less inaccessible, but there was open water on the north of Novaya Zemlya in August. On the east coast of Greenland the ice-belt was narrow, and there appears to have been less drift from the north than usual. Bering Strait was open in June, but the north coast of Alaska not until late in July. Commander C. I. H. Speerschneider, the editor of the report, comments on the facts that for several years, and particularly in 1925, little old ice was found in the east Greenland or east Spitsbergen currents, and that most of the ice was of one winter's formation. The report is illustrated with distribution charts for the months of April until August.

VAPOUR PRESSURES OF HYDROGEN CYANIDE.—A series of vapour pressure measurements of solid and liquid hydrogen cyanide is published in the *Journal of the American Chemical Society*, February. The observed values are compared with those obtained by calculation and, in the case of the liquid, with some isolated results of previous works. Values of the latent heats are given which have been calculated from the Clapeyron equation.

PROTEIN DIGESTION BY ENZYMES.—Under the general guidance of R. Willstätter, German chemists are making a great effort to isolate purer enzyme preparations, and in *Die Naturwissenschaften* for Feb. 19, 1926, Ernst Waldschmidt-Leitz gives a general account of the manner in which work of this type with proteases tends to modify current views as to protein hydrolyses by enzymes. By a laborious method of fractional precipitation, ereptase and tryptase have been obtained completely free from contamination with each other, and a study of their catalytic action has necessitated the revision of earlier conclusions drawn from work with less pure enzyme preparations. It is now found that ereptase is without action upon any but simple di- or tri-peptides; peptones, etc., being left quite unattacked. In addition to ereptase, the conclusion is drawn that at least three other types of protease must be distinguished, namely, peptase, tryptase not activated by enterokinase which is without action on the more complex proteins, and tryptase with enterokinase, a system which will attack such proteins. On the other hand, working with these purer enzymes, the ereptase from different sources appears to be identical in nature, and the differences reported in the behaviour of the same protease towards synthetic and naturally produced polypeptides have disappeared. In the light of this experimental study of proteases with which he has been associated, Waldschmidt-Leitz points out that the constitution of the protein molecule may have to be reconsidered from the point of view that it contains different types of chemical linkage, accessible to different types of hydrolytic enzyme.

SHOCK-WAVES OF HIGH EXPLOSIVES.—Certainly one of the most interesting and suggestive of the papers issued by the Safety in Mines Research Board is that numbered 18, "On the Pressure-Wave sent out by an Explosive," by Messrs. W. Payman and H. Robinson. To investigate the nature and the velocity of the invisible 'shock-waves' transmitted through the air by the sudden expansion of a confined volume of gas, the authors employed a modification of the 'Schlieren' method first developed by Töpler. The light of a brilliant, but very rapid, spark from a battery of Leyden jars is focussed on to a camera by means of a concave mirror of stainless steel—the beam of light crossing the field in which the shock-wave is transmitted. In front of the camera an opaque diaphragm is fixed so as to cut off the light from one half the lens. When a wave of compressed gas passes between the mirror and the camera, the light passing through it is refracted so that one half the beam is stopped by the diaphragm and the other half enters the lens. One half of the image of the wave comes out bright on the photograph and the other half is dark. With this apparatus photographs have been taken of the shock-waves produced both by the sudden release of compressed gases and by the firing of gas-mixtures and of high explosives. The authors have caught a shock-wave, started from a spark-ignition in electrolytic gas, as it emerges from a tube ahead of the flame, and in succeeding photographs have shown the flame overhauling this pressure-wave and swallowing it up in the explosion-wave. The photographs beautifully illustrate the slowing down both of shock- and explosion-waves as they emerge from a tube and develop spherical waves. They show also the heating effect when a shock-wave strikes an obstruction—and this will form the main subject of the large-scale experiments to be carried out on the shock-waves produced by firing modern explosives in coal.

Production and Properties of Large Single Crystals of Metals.

THE study of matter in the crystalline state is of importance at the present time to workers in so many branches of the pure and applied sciences that a paper by P. W. Bridgman, in vol. 60 of the *Proceedings of the American Academy of Arts and Sciences* of October 1925, on "Certain Physical Properties of Single Crystals of Tungsten, Antimony, Bismuth, Tellurium, Cadmium, Zinc, and Tin," will be read with far more than usual interest. With the exception of tungsten, all these metals crystallise in systems other than cubic, zinc and cadmium being hexagonal; bismuth, antimony, and tellurium trigonal; and tin tetragonal. The tungsten crystal, prepared in another manner, was included in the research merely as a result of the fact that a large crystal was placed at the author's disposal.

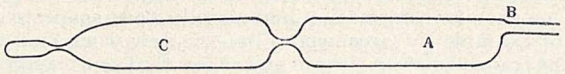

FIG. 1.—The mould used in producing single crystals.

Although much work has been done on single crystals of metals lately, the major portion has related to crystals which have been produced by some form of mechanical treatment followed by an appropriate annealing. It is not yet definitely known to what extent the mechanical deformation has impressed on the material specific characteristics which have persisted despite the reheating. Work, therefore, which is done on virgin crystals, never at any stage of their history stressed above their elastic limits, is not only of fundamental interest in itself, but has also a by no means unimportant value in connexion with the interpretation of results obtained on crystals produced by some form of work.

The method used by the author, by means of which single crystals up to nearly an inch in diameter have been made, consists in melting the metal in a suitable mould of quartz or refractory glass tubing and allowing the tube to pass slowly out of the furnace into the air or into a bath of oil. Solidification then starts at the bottom of the tube and proceeds slowly upwards, keeping pace with the lowering. If this be sufficiently slow, and provided that only one nucleus forms at the bottom of the tube, the metal will usually crystallise as one grain, having the cylindrical shape of the mould. This still holds even where the metal passes through an allotropic change point between the temperature of solidification and that of the room. Further, it is of interest that in almost all cases, especially where the diameter of the tube is fairly great, the crystal formed has the plane of easiest cleavage, or slip, parallel to the axis of the casting.

Various details require attention if consistent success in the production of a single crystal is to be attained, and the shape of the mould finally used is indicated in Fig. 1. The bottom of the tubing is drawn down to a separate chamber connected to the main part *C* by a capillary 0·1 mm. or so in diameter. This fine orifice acts as a 'filter,' allowing one only of the several grains which may have formed to pass through into the mould proper. It is essential that fresh nuclei should not form in *C*, which demands complete freedom from particles of oxide or specks of dirt. The melting of the metal, therefore, is done in a pre-melting chamber *A* connected with *C* by another capillary and provided with a tube *B* by means of which the metal may be introduced in the first place, and by which connexion may later be made with a vacuum pump, allowing the metal to be melted without oxidation. The process employed thus consists of first placing in *A* the metal to be examined, evacuating the vessel and placing it in a horizontal position in an electric furnace. It is essential that all traces of gas should be removed from the melt, and this is done by rocking the furnace and washing the metal backwards and forwards in *A*. Bismuth is particularly difficult to free from the last trace of gas, and it may be necessary to manipulate the molten metal for an hour or more before all has been eliminated. The furnace is now rotated into a vertical position and the metal allowed to filter into the mould, admitting air, or some other gas under pressure, to accelerate the process. The mould may now be lowered from the furnace at a speed depending on the metal and the size of the casting. For crystals of 2·2 cm. diameter a speed so low as 4 mm. per hour is desirable, while for small castings, 60 cm. per hour may be used. Except for bismuth and tellurium, however, there is no danger in using too small rates of lowering. A shield to prevent draughts striking the tube is helpful and, in the case of cadmium, cooling in a bath of oil is preferable to cooling in air. To prevent the metal sticking to the mould, the latter is treated with oil before use; this is then removed with ether, and the latter removed by evaporation with a gentle flame played on the surface.

TABLE.

SUMMARY OF RESULTS.

Metals.*	Initial Linear Compressibility at 30° C. Pressure Unit 1 kgm./cm.².	Elastic Constant C.G.S.	Linear Thermal Expansion at 20° C.	Specific Resistance 20° C.	Average Temperature Coefficient of Resistance 0-100° C.	Initial Pressure Coefficient of Resistance at 0° C. Pressure in kgm.
Zinc II	$12{\cdot}98\times10^{-7}$	$26{\cdot}38\times10^{-13}$	$57{\cdot}4\times10^{-6}$	$6{\cdot}13\times10^{-6}$	0·00419	$-10{\cdot}87\times10^{-6}$
I	1·95	8·23	12·6	5·91	0·00418	− 6·55
Cadmium II	18·3	36·9	52·5	8·30	0·00428 (?)	−13·1
I	2·1	12·9	20·2	6·80		− 8·7
Bismuth II	15·92	28·7	13·96	138	0·00445	+24·5
I	6·62	26·9	10·36	109		+ 7·5
Antimony II	16·48	33·8	15·56	35·6	0·00595	+17·2
I	5·26	17·7	7·96	42·6	0·00511	+ 1·05
Tellurium II	−4·14	23·4	−1·6	56000	—	—
I	27·48	48·7	27·2	154000	—	—
Tin II	6·72	11·8	30·50	14·3	0·00447	−10·96
I	6·02	18·5	15·45	9·9	0·00469	−10·28

* II, in a direction parallel to the axis of rotational symmetry.
I, in a direction perpendicular to the axis of rotational symmetry.

In the examination of the crystals, it was necessary to determine the orientation, and a very simple manner in which this is done is described, depending on the small 'negative' crystalline facets formed on the surface, the necessity of resorting to X-ray examination being avoided.

A short list of the more important values obtained will be found in the table above, but there are very many points of general interest which are recorded. The author agrees with other workers in mentioning

that the elastic limit of many of these single crystals is often "unbelievably" low. It is much to be regretted that so far no attempt has been made to examine the behaviour of the crystals at stresses higher than the elastic limit, an aspect of the work which is much to be desired.

It will be seen from the table that, broadly, the linear compressibility, the extension under tension (save in the cases of tin and tellurium), the thermal expansion, and the specific resistance are greater in a direction along the axis of rotational symmetry than in one at right angles. There are certain exceptions, however, and for tellurium the compressibility along the trigonal axis is negative, so that on subjecting the crystal to hydrostatic pressure it actually elongates in that direction; in the same direction also this element has a negative value for the thermal expansion. Antimony also furnishes an exception to the last of the generalisations, though here the exception may be regarded as being of a temporary nature, since at high pressures the metal becomes normal. With the exception again of antimony, which, however, behaves normally when the pressure is sufficiently increased, the temperature coefficients of resistance are not much affected by the orientation of the crystal. The effect of pressure on the resistance is, however, more affected by the direction of the current. It may be noted that, although pressure diminishes the resistance of cadmium, zinc, and tin, it increases that of both bismuth and antimony. In general, the statement may justifiably be made that the electrical properties show much less variation with the orientation of the crystal than do the mechanical ones.

Little work is recorded so far as the magnetic properties of these crystals are concerned, but a few, by no means uninteresting, observations are made. In the cases of bismuth and antimony there is a very definite directional effect. Bismuth sets itself with the trigonal axis parallel with the lines of force, the permeability being greatest along this axis, thus confirming the observation first made perhaps by Tyndall. In the case of antimony the crystal arranges itself with the cleavage plane parallel to the lines, the effect being even stronger than that in the case of bismuth. Tin also showed rather curious properties. On making the field (about 15,000 gauss) there was no observable effect, but when the field was broken, a kick occurred in such a direction as to tend to cause the tetragonal axis to come into line with the magnetic field. When the axis was already aligned with the field this kick was not shown.

The results of the specific resistance measurements are of general interest in connexion with the resistances of aggregates of the same metals. Knowing the specific resistances for a crystal along and perpendicularly to the axis of rotation $\rho_{//}$ and $\rho_{\prime}$ respectively, Voigt has shown that the resistance ρ of a haphazard aggregate should be given by the equation

$$\frac{1}{\rho} = \frac{1}{3}\left[\frac{2}{\rho_{\prime}} + \frac{1}{\rho_{//}}\right].$$

This calculated value for the aggregate is given in several cases and is consistently lower than that directly determined. Thus for cadmium the value for the aggregate thus calculated is $7{\cdot}24 \times 10^{-6}$ ohms per cm. cube, while observed values are 7·51 and $7{\cdot}54 \times 10^{-6}$ ohms. Again, for tin, the results give a calculated value for the aggregate of 11·06 microhms per cm. cube against the determined figure (Bureau of Standards) of 11·5 ohms. The author explains the differences by assuming that his own material was purer than any hitherto measured, which to some extent may be sufficient. There is, however, an alternative explanation. In the aggregate there are crystal boundaries the resistance of which, it is highly probable, is higher than that of the crystalline matter itself. The calculations in the paper under review cannot take into account any such changes brought about by boundary conditions within the mass, and the differences between the calculated values and those observed may therefore be regarded as offering confirmation of the idea that the crystal boundaries are regions of relatively high electrical resistance.

Prof. Bridgman's work has also fully demonstrated the fact that under pressure cadmium can be transformed first into one and then into a second allotrope. One such transformation had already been suspected, for example by Greenwood, but the new work makes the transformation certain and shows that two changes can be induced. The space lattices of the new forms are not yet known, but there is here in some ways the first absolutely direct evidence that under stress a change of lattice may be produced. In Fig. 2 the

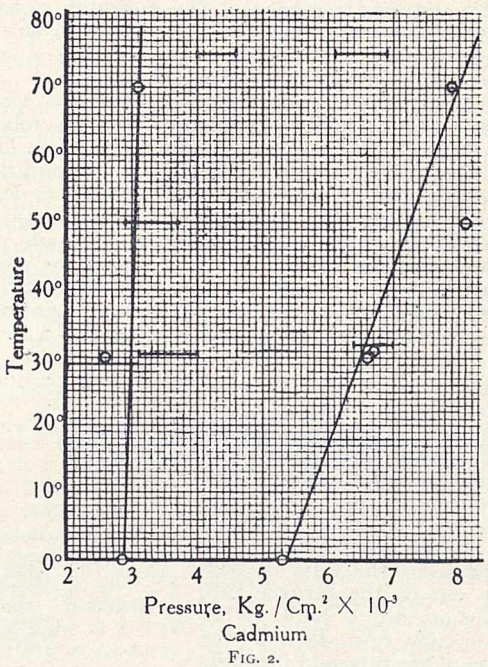

FIG. 2.

effect of temperature on the stress required to effect the modification is shown. Volume changes of the order of 2 per cent. may occur, which may be either positive or negative. At first the transformations are more or less reversible, but after several changes of (hydrostatic) pressure in reversed directions, the discontinuity usually becomes gradually less marked and finally almost disappears.

Finally, there are two statements which are of importance in connexion with the crystallographic changes which occur when a metal is forced through an orifice. In extruded wires of cadmium, the properties suggest that there is a preponderance of crystals with the hexagonal axis lying more or less parallel to the axis of the wire. Tin shows a similar effect very clearly. The temperature coefficient of specific resistance of a single crystal, for example, measured in a direction parallel to the tetragonal axis is 0·00447 and perpendicular to this axis 0·00469. The corresponding value obtained for an extruded wire of Kahlbaum tin was 0·00447, *i.e.* that which would be obtained if this wire was so orientated that the tetragonal axis of all the constituent crystals had been rotated into parallelism with the axis of the wire.

F. C. T.

The Courtship of Birds.

PROF. JULIAN HUXLEY and his co-workers have recently made some further contributions to the subject of the courtship of birds, dealing with three species of waders which were kept under close observation during two visits to the Texel.

The extent to which special courtship performances are developed in the order differs widely as between one species and another. Thus, the avocet (J. S. Huxley, *British Birds*, 1925, 19, 88) has no courtship at all. There is an invitatory attitude adopted by the female immediately before coition, responsive excitement on the part of the male, and a post-nuptial ceremony in which the pair run forwards together with the cock's half-spread wing over the hen's back—but of true courtship nothing.

On the other hand, the black-tailed godwit (J. S. Huxley and F. A. Montague, *Ibis*, 1926, 1) exhibits an elaborate courtship behaviour. There is a ceremonial flight accompanied by a special call, which is performed by the male and is probably associated with the territorial instinct. Then there is a tail display by the male, performed on the ground before the female, which is a true courtship activity. There is also a scrape ceremony, mainly performed by the male, which is obviously derived from the nesting instinct. Both birds, further, take part in a joint flight, and there is pursuit of the female by the male, hostility between rival males, and a coition ritual. The whole makes up a complex series of events.

The oyster-catcher (J. S. Huxley, assisted by F. A. Montague, *Ibis*, 1925, 868) seems to occupy an intermediate position in regard to the development of courtship activities. Special interest attaches to the piping performance, which consists of continuous piping while the neck is thrust forward and the head and the open beak are directed downwards: this may be accompanied by bobbing of the body or, more often, by dancing movements. It is shown that this is not of purely courtship significance, and that it is performed by both sexes and in varying circumstances. "It may be merely an expression of general sexual excitement, performed by a single bird without special relation with other birds. Or it may be a display definitely directed at another bird, which may or may not be the mate, and may or may not join in; or it may be a definite sign of hostility, either by one bird of a pair to a single intruder of the same sex, or by one pair to another. Or, finally, it appears that sometimes, where hostility might be expected, extra birds may be allowed to join a performance, in which case social excitement also seems to come into play."

The League of Nations Cancer Inquiry.

THE death rate from cancers of the breast and uterus in England is much higher than it is in Holland or Italy. The Health Organisation of the League of Nations appointed an international committee, with Sir George Buchanan as chairman, and also a committee of statisticians, presided over by Dr. M. Greenwood, to look into the matter, and the first results have now been published.[1] The greater part of the reports is occupied by elaborate statistical surveys of the available data for England by Dr. Greenwood, for Holland by Dr. H. W. Methorst, and for Italy by Prof. A. Niceforo, and their analysis is directed particularly to the relation of marriage age and place to the incidence of these forms of cancer. The non-technical reader will find the introductory summary easier to follow, and there is room for a still simpler abstract which, with a few diagrams, would deserve wide circulation among medical men.

The Committee finds that the three countries differ in their mortalities as stated, and significant differences of rate occur in the different divisions of each country: in England, cancer of the breast is most prevalent in the east and south, in Holland on the western coast, in Italy north of Rome. The Committee agrees in providing very full confirmation of the belief that cancer of the breast falls most heavily on unmarried women, cancer of the uterus on those who have been married. It is also shown definitely that women who develop cancer in either site are less fertile than those who do not.

These results are something more than confirmations of what was already known or suspected, for they are based on such comprehensive considerations that they reach an order of validity, exceptional in medical literature, which makes it necessary that any hypothesis on the cause of cancer should not be incompatible with, and should ultimately explain, them. Having securely established the facts, the Committee proceeded to look for an explanation of them. So far the results of this inquiry have been uniformly negative: the circumstances investigated have been those personal factors which are dealt with in hospital records; more may be obtained when the domestic and social sides of life are considered. The whole report is an excellent example of what the League can do in such matters, and we hope for much more of the same kind of solid work.

[1] Société des Nations: Organisation d'hygiène; sous-comité du Cancer. Rapport sur les résultats des enquêtes démographiques dans certains pays. (C.H. 333, Vol. 1.) Pp. 168. Rapport sur les résultats de certaines enquêtes, clinique se rapportant aux différences de mortalité cancéreuse dans certains pays choisis spécialement. (C.H. 333, Vol. 2.) Pp. 392. (London: Constable and Co., Ltd., 1925.)

University and Educational Intelligence.

ST. ANDREWS.—The Senatus Academicus has resolved to confer the Honorary Degree of LL.D. on Dr. E. F. Armstrong, Director of the British Dyestuffs Corporation; Dr. George Forbes, distinguished by his pioneer work in electrical engineering and popular writings on astronomy; Mr. E. S. Harkness, of New York, founder of the Commonwealth Fund; and Prof. E. T. Whittaker, professor of mathematics and Dean of the Faculty of Arts in the University of Edinburgh. The degrees will be conferred at the Graduation Ceremonial to be held on June 29.

THE Air Ministry announces that Sir Charles Wakefield, Bart., has generously offered to continue the 'Sir Charles Wakefield' Scholarships, founded by him in 1920. These scholarships are each of 75*l*., tenable for one year at the R.A.F. Cadet College, Cranwell, and are intended to give financial assistance to successful candidates for entry into the College. Two scholarships are awarded at each half-yearly entry. One of these is awarded on the result of the open competitive examination for admission to the Cadet College held in June and November, and the other to one of the aircraft apprentices who at the conclusion of their training at the R.A.F. training establishment at Halton are selected twice a year for flight cadetships at Cranwell.

THE Ministry of Agriculture and Fisheries is prepared to receive by, at latest, May 15, applications for grants in aid of scientific investigations bearing on agriculture to be carried out in England and Wales during the academic year beginning October 1, 1926. A prescribed form of application (A. 53/TG) giving particulars of the conditions under which the grants

are offered, may be obtained from the Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W.1 The Ministry also invites applications for a number of research scholarships in agricultural and veterinary science which will be tenable for three years and be of the annual value of 200*l.*, plus, possibly, allowances for travelling and subsistence abroad. Copies of application form 900/TG are obtainable from the Secretary, and must be returned not later than June 30.

WE have recently received the report for the year 1924-25 of University College, London, which shows a total student enrolment (3033) exceeding by 198 the total for the preceding year. The enrolment for the current session is likely to be still larger. The total includes 388 evening students and 214 attending vacation courses. Excluding these there were 1911 undergraduate and 520 post-graduate and research students. More than one-fifth came from homes beyond the British Isles, including 230 (83 post-graduate and research) from various parts of the Empire. India and Ceylon contributed 124 (43), Australia 24 (14), Canada 10 (5), New Zealand 12 (7), South Africa 27 (7), the figure in brackets indicating the number of research students. Among foreign countries, the United States of America were represented by 52 (24), Japan by 41 (11), Germany by 51 (3), Switzerland by 39 (1), France by 32, Holland 21 (2). The large number (148) of post-graduation and research students from beyond the British Isles is noteworthy. Free public lectures have for many years been a conspicuous feature of the work of the College. In 1924-25 they were attended by more than 6,000 persons. The list of appointments in other countries obtained by members of the College, staff and students, during the year includes professorships at McGill, Dalhousie (Halifax), Mysore, Cape Town, and Vassar.

IN a pamphlet entitled "The New University of Reading: some ideas for which it stands," Principal W. M. Childs gives prominence to the idea that the collegiate or residential principle, so characteristic of Oxford and Cambridge, is indispensable to the fulfilment of the highest functions of a university. Among these functions is training in character and living as well as opportunity for acquiring knowledge, and the corporate life of the students is the most favourable medium for such training. An instructive parallel is drawn between the academic and the economic worlds: "The whole world is sick because in getting rich and progressive something essential to human contentment has been lost or greatly mutilated; namely, personal relations. . . . Is it proposed to transfer this sickness from the sphere of economics to the sphere of education?" If not, it is essential that conditions should be favourable for the development of individual personal contact of teacher with student, and student with student. The residential halls of Reading, accommodating no less than 70 per cent. of the full-time students, represent the greatest achievement of the movement for establishing such conditions in the modern provincial universities and university colleges. Another subject dealt with in the pamphlet is "Universities and Research," in connexion with which attention is directed to the recent constitution of a Research Board with a general responsibility and mission for promoting and stimulating research in fields other than that covered by the work of the National Institute for Research in Dairying (which is a part of the University of Reading) and of administering to that end funds entrusted to it by the Council (for 1925–26, 500*l.*).

Contemporary Birthdays.

April 17, 1863.	Dr. George Grant MacCurdy.
April 21, 1871.	Sir Sydney John Chapman, K.C.B.
April 22, 1840.	Mr. Richard Inwards.
April 23, 1869.	Prof. Percy Edward Newberry.
April 24, 1841.	Prof. Charles Sprague Sargent.

Dr. MACCURDY, the distinguished American anthropologist, was born at Warrensburg, U.S.A. Graduating at Harvard, he studied afterwards at the Universities of Vienna, Paris, and Berlin. His connexion with Yale University dates back some thirty years. Since 1923 he has been accorded the status of professor and curator of the anthropological collections in Yale. Dr. MacCurdy was the first director (1921) of the American school in France for prehistoric studies. He is the author of "The Eolithic Problem" (1905), and "Human Origins" (1924, 2 vols.).

Sir SYDNEY CHAPMAN, permanent secretary of the Board of Trade since 1919, was born at Wells, Norfolk. He was educated at Manchester Grammar School and Owens College, graduating from thence at Trinity College, Cambridge. Lecturer in economic and political science in the University of Cardiff from 1899 until 1901, he returned to Owens College to take up the post of professor of political economy, retaining this for sixteen years. Sir Sydney was president of Section F (Economic Science and Statistics) at the British Association's Winnipeg meeting in 1909. The general topic of his address related to the value of leisure, the bearing of industrial development upon it, and its effectiveness in shaping economic arrangements. He has been a recipient of the Guy medal of the Royal Statistical Society.

Mr. INWARDS was born at Houghton Regis. For many years engaged in mining engineering and kindred enterprises in Bolivia, Mexico, and other parts of the world, he finally settled in England. Joint editor for two decades of the *Quarterly Journal of the Royal Meteorological Society*, he was the Society's president in 1894–95.

Prof. PERCY NEWBERRY, honorary reader in Egyptian art at the University of Liverpool, was educated at King's College School, London, and King's College. Beginning the study of Egyptology in 1884, his acquirements and exactitude in procedure qualified him to be officer in charge (1890) of the archæological survey of Egypt, conducted under the auspices of the Egypt Exploration Fund. Brunner professor of Egyptology in the University of Liverpool from 1906 until 1919, Prof. Newberry was president of Section H (Anthropology) at the British Association's meeting in that city in 1923. He gave an address on "Egypt as a Field for Anthropological Research."

Prof. SARGENT, the veteran American botanist, who is a foreign member of the Linnean Society of London, was born at Boston, U.S.A., and graduated at Harvard University. Sometime director of the Boston Botanic Gardens, it was Sargent who organised the Jesup collection of North American woods for the American Museum of Natural History, New York. He was one of the commissioners (1896) detailed to report upon a forest policy for the forestry lands of the United States. He is the author of "A Manual of the Trees of North America," and "The Forest Flora of Japan."

Societies and Academies.

LONDON.

Linnean Society, March 4.—E. **Heron-Allen**: The iconography of a myth. The legend that the stalked barnacle, *Lepas anatifera*, upon trees overhanging the water, or upon rotten timber, and, at maturity, produces a goose or duck, permeates scientific literature from the eleventh to the seventeenth centuries, and since the invention of printing has been fancifully illustrated. The myth appears to have passed current in the Near East in 1000 B.C., and is illustrated upon Mykenæn pots.—C. J. **Stubblefield**: Notes on the development of the trilobite, *Shumardia pusilla* (Sars). A large number of complete specimens have been collected, ranging in length from 0·24 mm. in the earliest or 'Protaspid Period' to 4·91 mm. in the latest or 'Holaspid Period.' The six thoracic segments are released one by one from dorsal fusion in the posterior shield or 'transitory pygidium.' *S. pusilla* offers new evidence in favour of the hypothesis, advanced by Beecher in 1896, that the growing point of the new segments in trilobites was in front of the most posterior or anal segment.—H. Graham **Cannon**: On the post-embryonic development of the fairy shrimp (*Chirocephalus diaphanus*). The development of *Chirocephalus diaphanus* is essentially similar to that of Estheria. Cœlomic sacs are formed as in the latter, but do not attain any considerable size owing to the precocious development of the pericardial cavity. The method of heart-formation differs in different parts of the body. The development of the maxillary gland shows no essential differences from that of Estheria. The antennal gland shows very clearly, between end sac and duct, a sphincter consisting of three cells connected directly to the cuticle. The musculature is more complex than that of Estheria, there being a series of 'connective muscles' between the dorsal and ventral longitudinal muscles. The dorso-ventral muscles, the proctodæal dilators, and probably the stomodæal dilators are of ectodermal origin.—H. W. **Pugsley**: Further notes on Fumaria and Rupicapnos. The material, largely the fruit of recent French botanical expeditions into parts of Morocco hitherto unexplored, has yielded some new species both of Fumaria and Rupicapnos. New forms were also discovered in Algeria during a visit to that country in 1922.

Geological Society, March 10.—J. E. **Marr**: The Pleistocene deposits of the lower part of the Great Ouse Basin. A period of aggradation in Lower Palæolithic times intervened between two periods of glaciation of the district, and after the second glaciation, erosion occurred, with minor periods of aggradation in Upper Palæolithic times. An appendix by A. S. **Kennard** and B. B. **Woodward** deals with the non-marine mollusca.—W. G. **Woolnough** and Sir T. W. Edgeworth **David**: Cretaceous glaciation in Central Australia. Evidences of glacial action in Central Australia were recorded more than forty years ago, mostly in the form of numerous erratics and occasional beds of tillite. The occurrences are now known to belong to two distinct geological horizons, the older almost certainly Permo-Carboniferous, and the newer probably Jurassic to Cretaceo-Tertiary. Recently, one of the authors (W. G. W.), when exploring the salt-lakes of Central Australia on behalf of Brunner, Mond and Co., discovered good evidence as to the age of the later glaciation. The most recent expedition (by W. G. W.) has led to the discovery by him of marine fossils in the same matrix as that in which the erratics are embedded. The erratic-bearing beds, together with a thick series of freshwater strata with lignites, which mostly overlie the glacial deposits, are termed the Winton Series. They are followed by strata making locally a distinctly unconformable junction with them and probably of early Tertiary age. These latter beds belong to the Eyrian Series, which in places carries fossil leaves of Eucalyptus. F. W. Whitehouse opines that the age may approximate to Albian. If so, it would accord with the New Zealand evidence of a great orogenic movement in those islands soon after the close of Neocomian time. It is suggested that the crust-movements, which were orogenic in New Zealand, expressed themselves as epeirogenic uplifts in Australia and accounts for the fact that the Cretaceous Mediterranean of Australia gave place soon after the close of Aptian time to a vast freshwater lake: for marine sedimentation, although in places represented by small patches of Albian, mostly ceased even before Albian time.

Physical Society, March 12.—A. H. **Davis**: The analogy between ripples and acoustical wave phenomena. The analogy between cylindrical sound waves and waves on the surface of a liquid is studied. For inviscid media, as regards velocity potential, the differential equations are similar provided the disturbance is small and is harmonic in type. The effect of moderate viscosity is of the same type for sound waves and for surface waves; it is most marked for short wave-lengths, and it decreases amplitudes without appreciably altering the wave-length. Viscous effects are generally negligible in the case of sound, but they are appreciable for the water waves that would usually be used in a small ripple tank not greater than, say, 10 feet in size. Mercury waves are much less affected by viscous damping than water waves. Experiments with model obstacles in a ripple tank show that the effects of the meniscus around the obstacle and of the amplitude of the source are not important. When the water becomes stale on exposure—and presumably contaminated—the relative distribution of ripples around obstacles is appreciably modified, but not to an extent which would correspond to any very marked change in the loudness of a sound. Experiments have also been conducted using an impulsive disturbance instead of a maintained train of waves. When it is recognised that a sound pulse travels out singly, whereas with ripples subsidiary wavelets accompany the main pulse, the correspondence between ripple photographs and sound pulse photographs is most striking.—R. M. **Archer**: On the evaporative losses of vacuum-jacketed vessels of the Dewar type. The evaporative losses of metal Dewar vessels are discussed, and particulars given of experiments made by the author in Oxygen Laboratory of the Air Ministry. The separation of neck and radiation losses is described, and also a method of testing adsorbents under working conditions.

CAMBRIDGE.

Philosophical Society, March 15.—A. **Sommerfeld**: Some controversial points in the theory of spectra. (Lecture.)—J. A. **Crowther**: A theory of the action of X-rays on living cells.

MANCHESTER.

Literary and Philosophical Society, March 9.—G. Elliot **Smith**: The brains of apes and men (Wilde Memorial Lecture). Without the cultivation of manual dexterity, which involves the aptitude to learn by experimentation, man's ancestors could not have acquired the seeing eye and the understanding

ear. Man's intellectual pre-eminence is based upon his ability really to see the things and events around him, to understand something of their significance and to appreciate their æsthetic qualities. Vision became also the chief instrument for determining his sexual selection and affecting his social behaviour in an infinite variety of ways. But it affects human thought and action in much more subtle and obtrusive ways. Apart altogether from the phenomena of consciousness, it helps unconsciously in controlling posture and regulating the tone of muscles, a function upon the effective performance of which skill is so largely dependent. The attainment of the erect attitude in the human family was intimately bound up with the increasing influence of the eyes and the cerebral cortex in the control of posture. The special interest of the apes' brains is that they provide the evidence to help us to get some idea of how vision acquired its ascendency. The casts obtained from the brain-case of extinct members of the human family—in particular those of Pithecanthropus, Eoanthropus, and the Rhodesian man—provide important evidence in confirmation of the fact that the processes of growth and elaboration of the brain, which can be studied in the lowlier primates, were continued within the human family itself. Moreover, they agree with the order of development of the cerebral cortex revealed in the brain of the modern child. The real importance of the interesting fossil ape found at Taungs in 1924 is that it reveals the earliest stage in this process of cerebral development and facial refinement.

PARIS.

Academy of Sciences, March 8.—A. **Lacroix**: The classification of leucite rocks: the types of the syenite family.—C. **Matignon** and J. **Cathala**: The action of phosgene on glucina. The work described by the authors in a recent communication was anticipated by Ed. Chauvenet in 1911.—Ch. **Moureu**, A. **Lepape**, H. **Moureu**, and M. **Geslin**: The composition (ordinary and rare gases) of the gases spontaneously evolved from some thermal springs of Madagascar and Réunion. Of the eleven waters examined, eight were from Madagascar, and all except one consisted mainly of carbon dioxide. All contained argon, but only one, from Ranomafana, contained appreciable proportions of helium (0·56 per cent.). The gases evolved were very similar to those obtained from the bicarbonate springs of the Central Plateau in France. This was rather unexpected, since the subsoil in the Antsirabé basin, from which seven out of eight of the Madagascar samples were obtained, is rich in radioactive minerals (betafite, euxenite, etc.), and consequently rich in helium.—Léon **Guillet** and Jean **Cournot**: The influence of thermal treatment on some silver alloys. A study of silver-zinc and silver-cadmium alloys. The alloys with zinc show very clearly the increase of hardening by reheating, in this resembling duralumin: for the silver-cadmium alloys the results are less evident.—R. de **Forcrand**: The action of thallium on alcohols or on dilute acids and on water and ethyl alcohol in excess. Thermochemical determinations.—Jean Baptiste **Senderens**: The etherification of the aromatic alcohols. Study of the conditions under which sulphuric acid can convert benzyl, phenylethyl (primary and secondary), and cinnamic alcohols into the corresponding ethers.—R. **Swyngedauw**: The velocity of the slack and taut fibres of a belt.—J. **Ottenheimer** and R. **Dubois**: A wave preceding the explosive wave.—Marcel **Laporte**: The measurement of the mobility of ions in gases. The method is analogous to that used by Fizeau for measuring the velocity of light. Experiments were conducted with air, oxygen, nitrogen, carbon dioxide, and argon. For all these cases it is necessary to conclude that there exist ions of different mobilities, the values of which are comprised between two clearly different limits. Values given by other experimenters fall between these limits.—Max **Morand**: Study of the working of a positive ray tube. — G. **Ribaud**: The influence of the external temperature on the temperature of standard pyrometric lamps.—R. de **Fleury**: Pistons of aluminium, alpax, and magnesium. —W. **Perschke**: The study of triboluminescence.—P. **Job**: The spectrographic study of trihalogen salts of potassium. The method described has indicated the existence of KI_3, KBr_3, $KBrI_2$, $KClBr_2$, and $KClI_2$.—A. **Bigot**: Kaolins, clays, etc. Formation of the clay schists of the coal measures.—Clément **Duval**: Preparations of the nitrite of *cis*-dinitrotetrammine and of some bodies derived from it.— — **Lespieau**: The action of acrolein on the mixed dimagnesium derivative of acetylene. One of the products of this reaction is a new penteninol $CH \equiv C - CH(OH) - CH = CH_2$, the physical and chemical properties of which are described.—Marcel **Guerbet**: The asymmetric dialkylarsinic acids and, in particular, methylethylarsinic acid.—Mlle. Y. **Brière**: The existence of uraninite (pitchblende) in certain pegmatites from Madagascar. Although many radioactive minerals have been found in Madagascar, this is the first occasion of finding pitchblende.—M. **Koyitch**: The existence of leucitic lavas in southern Serbia.—A. **Demay**: The tectonic signification of lustrous gneiss of the Pilat massif, near Saint-Etienne.—Ch. **Maurain**: Magnetic measurements in the west of France.—Jean des **Cilleuls**: The phytoplankton of the Loire.—V. **Lubimenko**: The physiological rôle of the starch deposited in the green parenchyma of leaves.—H. **Lagatu** and L. **Maume**: The diagnosis of the food of a plant by the chemical evolution of a suitably chosen leaf.—A. **Dognon**: The biological action of X-rays of different wave-lengths. Reply to a criticism by M. Dauvillier. —P. **Petit** and **Richard**: The mechanical liquefaction of starch paste.—M. **Bridel** and C. **Béguin**: The action of emulsin from almonds on *l*-arabinose in solution in ethyl alcohol of different strengths.—G. **Guittonneau**: The microbial oxidation of sulphur. Further experiments confirming the view put forward in an earlier communication that the first product of the oxidation of sulphur in soil by micro-organisms is a thiosulphate.—Georges **Truffaut** and N. **Bezssonoff**: The influence of metallic aluminium on the activity of nitrogen-fixing bacteria. Larger proportions of nitrogen are fixed in the presence of metallic aluminium.—M. **Marage**: The defence of the organism against medicaments.—**Roucayrol**: The action of diathermy in blennorrhagia.

VIENNA.

Academy of Sciences, February 4.—G. **Stetter**: (Communication of the Radium Institute, No. 181.) The determination of the ratio charge to mass for natural H-rays and atomic fragments from aluminium. (No. 182.) The components of the $K\beta_1$ line of iron.—K. **Przibram**: On the interpretation of the colour changes in salts; preliminary communication dealing with colours of alkali haloid crystals.—P. **Weiss**: (Communication of the Biological Experiment Institute of the Academy of Sciences in Vienna, No. 128.) The origin of the skin in regenerated extremities of *Triton cristatus*.—L. **Abolin**: (Communication of Biological Institute, No. 129.) In-

fluence of chemicals on the colour changes of fishes. The influence of central and peripheral nerve-poisons on the whole chromatophore system of the minnow, *Phoxinus laevis*. Strychnine and other poisons produced a darkening of the fish due to expansion of the melanophores.—R. Müller, F. Griengl and J. Mollang: The electro-chemistry of nonaqueous solutions (vii.). Conductivity measurements in dilute solutions of silver nitrate in twelve organic solvents and determination of the limits of molar conductivity. —M. Eisler and L. Portheim: Further researches on hæmagglutinines in plants. Extract of the ripe seeds of *Phaseolus multiflorus* has the power of coagulating red blood corpuscles. Hæmagglutinin also occurs in seeds of *Ricinus communis*, seeds of *Datura Stramonium* and tubers of artichoke, *Helianthus tuberosus*. —V. Oberguggenberger: Earth current observations in the mountains.—F. E. Suess: The structure of variscic primitive rocks.

February 11.—T. Kautz: (Radium Institute, No. 183.) Determination of the half period of radium D by measuring the heat evolved by an old radium preparation.—E. Rona: (Radium Institute, No. 184.) Determinations of the absorption and range of natural H-rays.—E. Gebauer-Fülnegg and Riess: Quinone-sulphur-imines.—C. Diener: The fossil deposits in the Hallstätter limestones of the Salzkammergut.—L. Kober: New contributions to the geology of the eastern Tauern and the Salzkammergut.

February 18.—J. Lense: Special ametric manifolds.

WASHINGTON.

National Academy of Sciences (Proc. Vol. 12, No. 2, February).—Charles E. St. John: The red shift of solar lines and relativity. The general displacement of spectral lines towards the red required by relativity is found, but there are noteworthy discordances between theoretical and observed values. The deviations are correlated primarily not with intensity but with the level in the sun's atmosphere at which the lines in question are produced. Generalised relativity provides a general displacement due to the slowing-up of the atomic clock. The Doppler effect, due to radial movements in the solar atmosphere, explains systematic deviations of high- and low-level lines. Differential scattering, owing to the longer path in the solar atmosphere traversed by light from the limb, accounts for the increased displacement of lines from the limb (limb effect).—G. W. Keitt: Some relations of environment to the epidemiology and control of apple scab. Apple scab (*Venturia inæqualis* (Cke.) Winter) has been studied in the field and under controlled conditions. In Wisconsin, the fungus winters in infected leaves on the ground and in spring ascospores are shot out and carried by air currents to the trees, where infection is spread by conidia. The optimum temperature for infection and ascospore germination is about 20° C. Fluctuations in humidity have little effect. Sulphur fungicides are most effective against scab.—E. O. Salant: Infra-red absorption of the N-H bond. Examination of a series of symmetrical dialkyl and trialkyl amines indicates that the N-H bond has a characteristic fundamental vibration frequency varying between wave-numbers 1400 and 1700, according to the other atoms in the molecule.—F. R. Bichowsky and H. C. Urey: A possible explanation of the relativity doublets and anomalous Zeeman effect by means of a magnetic electron. It is assumed that the electron is a charged magnetic doublet of the magnetic moment of half a Bohr magneton and the perturbing effect of other electrons is neglected. Half-quantum numbers are adopted, the total magnetic moment of an atom being assumed to be contributed half by the electron rotating on itself and half by its rotation round the nucleus.—F. Zwicky: Theory of the specific heat of electrolytes.—T. Lyman and F. A. Saunders: The spectrum of neon in the extreme ultra-violet. Lines between λ630 and λ590 appear to be due to normal neon (Ne I); the spectrum of ionised neon (Ne II) extends to λ430.—Arthur J. Dempster: The free path of protons in helium. Protons accelerated through 900 volts potential difference pass freely through atoms of helium with only slight changes in velocity or direction. It is suggested that these protons, having much smaller velocities than the electrons in the atom, cause only a slow modification of the electronic orbits without producing permanent disturbance or ionisation.—W. M. Davis: Subsidence rate of reef-encircled islands. The formations in the open Pacific support the view that reef upgrowth occurred on foundations which subside at (1) a slow rate which can be counterbalanced by lagoon aggradation as well as by reef upgrowth, or (2) at a rapid rate which cannot be counterbalanced. Reef upgrowth is slower than coral upgrowth.—H. S. Vandiver: Summary of results and proofs concerning Fermat's last theorem.—G. V. Rainich: Mass in curved space-time. In the general relativity theory, the electric charge appears as a residue of a field derived from the curvature field; an expression of the type of a residue is obtained for mass in the centro-symmetric case. This mass constant appears to be connected with the complete Riemann tensor, and it seems that, in order to introduce mass, it is necessary to separate space and time.—Aristotle D. Michal: Concerning certain solvable equations with functional derivatives.—Joseph Miller Thomas: First integrals in the geometry of paths.—Luther Pfahler Eisenhart: Einstein's recent theory of gravitation and electricity. Equations which should replace Maxwell's equations are obtained in tensor form.—Oliver R. Wulf: Evidence for the existence of activated molecules in a chemical reaction. The heat of reaction when ozone decomposes does not afford sufficient energy for the excitation of the radiation emitted. This radiation agrees closely with the emission spectrum of ozone molecules, suggesting the presence of activated ozone molecules.—John J. Abel: Crystalline insulin. An insulin solution (40 rabbit units to the milligram) is taken up in acetic acid, and impurities are precipitated with brucine and removed. Treatment of the clear liquid with pyridine give a crystalline precipitate. Larger crystals are obtained by recrystallisation from disodium hydrogen phosphate. Amounts so small as 0·01 mgm. per kilo of the crystalline substance reduced the blood sugar of rabbits to the convulsive level.

Official Publications Received.

Union of South Africa. Department of Mines and Industries: Geological Survey. Memoir No. 23: The Economic Geology of Sabie and Pilgrims Rest. By W. J. Wybergh. Pp. 124+5 plates. (Pretoria: Government Printing and Stationery Office.) 5s. 6d.

Legislative Assembly, New South Wales. Report of the Director-General of Public Health, New South Wales, for the Year 1924. Pp. v+191. (Sydney: Alfred James Kent.) 8s. 3d.

Ministero dell' Aeronautica: Aviazione civile e traffico aereo. Ufficio presagi. Annuario 1926. Pp. 142. (Roma.)

Department of the Interior: Bureau of Education. Bulletin, 1925, No. 28: Statistics of Teachers Colleges and Normal Schools, 1923–1924. Pp. 60. 10 cents. Bulletin, 1925, No. 35: Review of Educational Legislation, 1923–1924. By William R. Hood. Pp. 22. 5 cents. (Washington, D.C.: Government Printing Office.)

Aeronautical Research Committee. Reports and Memoranda, No. 984 (Ae. 196): The Representation of Aircraft Performance Tests, using Non-Dimensional Variables, with special reference to the Prediction of the Effects of Change of Loading on Performance. By R. S. Capon. (A.4, a Full Scale Work—Aeroplanes general 125—T. 2098 and A.) Pp. 7+2 plates. (London: H.M. Stationery Office.) 4d. net.

Havsforskningsinstitutets Skrift. No 28: Isarna vintern 1922-23. Referat: Das Meereis im Winter 1922-23. Av Gunnar Granquist. Pp. 132. 30 Fmk. No. 30: Thalassologische Beobachtungen im Ålands- und Schärenmeer im Juli 1922 und Juli 1923. Herausgegeben von Rolf Witting und Hans Pettersson. Pp. 89. 7 Fmk. No. 32: Talassologiska vårexpeditionen 1924. Referat: Die thalassologische Terminfahrt im Jahre 1924. Av Risto Jurwa. Pp. 27. 4 Fmk. No. 33: Beobachtungen von Strom und Wind an den Leuchtschiffen im Jahre 1923. Von Erik Palmén. Pp. 26. 6 Fmk. No. 34: Regelmässige Beobachtungen von Temperatur und Salzgehalt des Meeres im Jahre 1923. Von Gunnar Granquist. Pp. 54. 10 Fmk. No. 35: Havsforskningsinstitutets värksamhet under år 1924. Redogörelse avgiven av Rolf Witting. Pp. 22. 4 Fmk. No. 36: Dagliga vattenståndsuppgifter 1923. Referat: Tägliche Wasserstandsangaben 1923. Av Henrik Renquist. Pp. 46. 8 Fmk. (Helsingfors: Statsrådets Tryckeri.)

The Indian Forest Records. Entomology Series, Vol. 12, Part 7: Descriptions of new Species of Niponiidae and Cerambycidae from India. By J. C. M. Gardner. Pp. 17+1 plate. (Calcutta: Government of India Central Publication Branch.) 6 annas; 8*d*.

Memoirs of the Department of Agriculture in India. Chemical Series, Vol. 8, No. 6: The Determination of available Phosphoric Acid of Calcareous Soils. Part i: Inapplicability of Dyer's Method to highly Calcareous Soils; Part ii: Extraction of Phosphoric Acid of Calcareous Soils with Salt Solutions; Part iii: Potassium Carbonate Method for Estimation of available Phosphoric Acid of highly Calcareous Soils. By Surendralal Das. Pp. 69-104. (Calcutta: Government of India Central Publication Branch.) 12 annas; 1*s*. 3*d*.

Transactions of the Natural History Society of Northumberland, Durham and Newcastle-upon-Tyne. (New Series), Vol. 6, Part 2. Pp. 115-242+lxxxvi+iv. (London: Williams and Norgate, Ltd.) 5*s*. 6*d*.

University Grants Committee. Returns from Universities and University Colleges in receipt of Treasury Grant, 1924-1925. Pp. 18. (London: H.M. Stationery Office.) 2*s*. 9*d*. net.

University of California Publications in American Archaeology and Ethnology. Vol. 18, No. 2: Clear Lake Pomo Society. By Edward Winslow Gifford. Pp. 287-390. 1.35 dollars. Vol. 22, No. 2: Californian Anthropometry. By Edward Winslow Gifford. Pp. 217-390+plates 2-53. 2.25 dollars. (Berkeley, Calif.: University of California Press.)

United States Department of Agriculture. Department Bulletin No. 1363: Host Relations of Compsilura concinnata Meigen, an important Tachinid Parasite of the Gipsy Moth and the Brown-Tail Moth. By R. T. Webber and J. V. Schaffner, Jr. Pp. 32. (Washington, D.C.: Government Printing Office.) 5 cents.

University of Washington Publications in Anthropology. Vol. 1, No. 2: The Distribution of Kinship Systems in North America. By Leslie Spier. Pp. 69-88+9 maps. Vol. 1, No. 3: An Analysis of Plains Indian Parfleche Decoration. By Leslie Spier. Pp. 89-112. Vol. 1, No. 4: Klallam Folk Tales. By Erna Gunther. Pp. 113-170. (Seattle, Wash.: University of Washington Press.)

The Institution of Mining and Metallurgy. List of Members (with Topographical Index), Constitution and By-Laws and Royal Charter of Incorporation. March 1926. Pp. 153. (London.)

Reports of the Council and Auditors of the Zoological Society of London for the Year 1925, prepared for the Annual General Meeting to be held on Thursday, April 29th, 1926. Pp. 79. (London.)

Diary of Societies.

SATURDAY, APRIL 17.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS, at 2.30.—Dr. R. Thiessen: The Contributions made by the Microscopical Study of Coal (Address).—Discussion on Paper by P. S. Lea on Haulage Accidents, and one by S. Burns on Winding Costs: A Plea to the Purchaser of Electric Winding Plant for Withdrawal of Stipulations which are not conducive to Economical Working.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Dr. W. T. Calman: The Shipworm (1).

MONDAY, APRIL 19.

INSTITUTION OF POST OFFICE ELECTRICAL ENGINEERS (at Royal Technical College, Glasgow), at 2.30.—Films: Travalogue of London and Rural Districts, with Special Reference to Telephone and Cable Development.—Creating the Instruments of Speech.

ROYAL GEOGRAPHICAL SOCIETY (at Lowther Lodge), at 5.—Dr. Vaughan Cornish: Harmonies of Tone and Colour in Scenery determined by Light and Atmosphere.

BRITISH PSYCHOLOGICAL SOCIETY (at London Day Training College), at 6.—A. G. Hughes: Number Games: their Value as Drill in Arithmatic.

INSTITUTION OF ELECTRICAL ENGINEERS (Mersey and North Wales (Liverpool) Centre) (Annual General Meeting) (in Liverpool University), at 7.—Prof. S. P. Smith: An All-Electric House.

INSTITUTION OF ELECTRICAL ENGINEERS (Tees-Side Sub-Centre) (at Cleveland Technical Institute, Middlesbrough), at 7.15.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.

ARISTOTELIAN SOCIETY (at University of London Club), at 8.—Dr. C. D. Broad: Kant's First and Second Analogies of Experience.

ROYAL SOCIETY OF ARTS, at 8.—C. R. Peers: Ornament in Britain (Cantor Lectures) (1).

CHEMICAL INDUSTRY CLUB.

TUESDAY, APRIL 20.

ROYAL STATISTICAL SOCIETY (at Royal Society of Arts), at 5.15.—H. W. Macrosty: Statistics of British Shipping.

SOCIETY OF CHEMICAL INDUSTRY (Chemical Engineering Group) (jointly with Birmingham Section) (at White Horse Hotel, Birmingham), at 5.30.—W. A. Benton: Measuring and Weighing Apparatus as applied to Chemical Works.—W. Hall-Simmons and F. C. Sutton: Rotameters in Chemical Industry.

ROYAL SOCIETY OF MEDICINE, at 5.30.—General Meeting.

INSTITUTE OF MARINE ENGINEERS, at 6.30.—W. Griffiths: Bearing Metals.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—C. Fabry: The Photographic Plate as a Measuring Instrument for Visible and Invisible Radiations (Hurter and Driffield Memorial Lecture).

INSTITUTION OF AUTOMOBILE ENGINEERS (at Royal Society of Arts), at 7.30.—H. S. Rowell: Experiments on Laminated Springs.

ROYAL ANTHROPOLOGICAL INSTITUTE (Indian Section), at 8.30.—L. H. Dudley Buxton: Ethnic Relations in India and the Near East.

MEDICO-LEGAL SOCIETY (at 11 Chandos Street, W.1), at 8.30.—C. Ainsworth Mitchell: Some Aspects of the New Regulations on Preservatives.

WEDNESDAY, APRIL 21.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Prof. J. Barcroft: Organs of Multiple Function: (2) The Spleen.

ROYAL METEOROLOGICAL SOCIETY, at 5.—Dr. J. Glasspoole: The Driest and Wettest Years at Individual Stations in the British Isles, 1868 to 1924.—C. E. P. Brooks: (*a*) The Meteorological Conditions during the Glaciation of the present Tropics, being some Remarks on the Climatological Basis of Wegener's Theory of Continental Drift; (*b*) The Variations of Pressure from Month to Month in the Region of the British Isles.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—L. R. Cox: *Anthracopupa britannica* sp. nov., a Land Gastropod from the Keele Beds of Northern Worcestershire.—H. P. Lewis: On *Bolopora undosa* gen. et sp. nov.: a Rock-Building Bryozoan with Phosphatised Skeleton from the Basal Arenig Rocks of Ffestiniog (North Wales).—Dr. C. A. Matley: The Geology of the Cayman Islands (British West Indies), and their Relation to the Bartlett Trough.—Sir T. W. Edgeworth David: Exhibition of Lantern-Slides illustrating the proposed new Deep Boring on the Great Barrier Reef, off Cairns (Queensland).

INSTITUTION OF ELECTRICAL ENGINEERS (Sheffield Sub-Centre) (at Royal Victoria Hotel, Sheffield), at 7.30.—Major E. I. David: Electricity in Mines.

ROYAL SOCIETY OF ARTS, at 8.—Major-Gen. Sir George McMunn: Some Aspects of the Business Side of an Army.

INSTITUTE OF CHEMISTRY (London Section).

SOCIETY OF GLASS TECHNOLOGY (Annual General Meeting) (at Sheffield).

THURSDAY, APRIL 22.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Prof. O. H. P. Prior: Anglo-Norman Literature: An Introduction.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Sir J. J. Thomson: The Mechanics of the Electric Field (Kelvin Lecture).

BRITISH ASTRONOMICAL ASSOCIATION (West of Scotland Branch) (at Royal Technical College, Glasgow), at 7.30.—Dr. J. K. Fotheringham: Early Astronomical Observations and their Value.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Literary and Philosophical Society, Newcastle-upon-Tyne), at 7.30.—H. Thomson: Humber Arm Hydro-electric Scheme.

CHEMICAL SOCIETY, at 8.—W. C. Reynolds: An Analysis of the Ether. Part II. The Magnetic Fields in Atoms.

C.B.C. SOCIETY FOR CONSTRUCTIVE BIRTH CONTROL AND RACIAL PROGRESS (at Essex Hall, Essex Street, Strand), at 8.15.—Lord Morris and Dr. Marie Stopes: Debate on Birth Control.

ROYAL SOCIETY OF MEDICINE (Urology Section), at 8.30.

OIL AND COLOUR CHEMISTS' ASSOCIATION.

FRIDAY, APRIL 23.

PHYSICAL SOCIETY OF LONDON (at Imperial College of Science and Technology), at 5.—Prof. C. Fabry: The Absorption of Radiation by the Upper Atmosphere (Guthrie Lecture).

SOCIETY OF CHEMICAL INDUSTRY (Manchester Section), at 7.—Sir Arthur Duckham: The Profession of the Chemical Engineer (Lecture).

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.—F. J. Hookham and others: What our Foreign Competitors are Doing.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—S. Turner: An Explorer in the New Zealand Alps (Lecture).

INSTITUTE OF METALS (Swansea Local Section) (at University College, Singleton Park, Swansea), at 7.15.—Annual General Meeting.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—Question and Discussion Evening.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Newcastle-upon-Tyne), at 7.30.—W. S. Burn: High-Powered Oil Engines.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Prof. R. Whiddington: The Luminous Discharge through Rare Gases.

SATURDAY, APRIL 24.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (at Neville Hall, Newcastle-upon-Tyne), at 3.—J. G. Taylor: Coal and its Banded Constituents.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Dr. W. T. Calman: The Shipworm (2).

CONVENTION, ETC.

APRIL 12 TO APRIL 27.

INTERNATIONAL FORESTRY EXHIBITION (at Milan).

APRIL 16 TO APRIL 20.

INTERNATIONAL SOCIETY OF MEDICAL HYDROLOGY (Annual Meeting will be held in Czecho-Slovakia). (Particulars from Dr. E. P. Poulton, at 36 Devonshire Place, W.1.)

APRIL 17.

OPTICAL CONVENTION (at Imperial College of Science and Technology):—At 10 to 12.—Reading and Discussion of Papers; at 12—Concluding General Meeting.

APRIL 29 TO MAY 5.

WORLD'S FORESTRY CONGRESS (at Rome).