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Nature

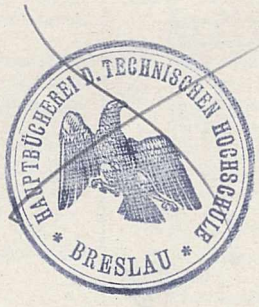
A WEEKLY

ILLUSTRATED JOURNAL OF SCIENCE

VOLUME CX

JULY, 1922, to DECEMBER, 1922

"*To the solid ground*
Of Nature trusts the mind which builds for aye."—WORDSWORTH.



London
MACMILLAN AND CO., LIMITED
NEW YORK: MACMILLAN COMPANY

1921.1002.

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BIBLIOTEKA GŁÓWNA

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Printed in Great Britain by R. & R. Clark, Limited, *Edinburgh*

NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"*To the solid ground*
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

SATURDAY, JULY 1, 1922.

CONTENTS.

Parliamentary Aid to Universities.

THERE is need for a clear definition of the present position in regard to Government grants for university education in Great Britain. Statements of a seemingly contradictory nature have been made, and it is not surprising that misunderstandings have arisen. On one hand we have the fact that the parliamentary votes for university education are reduced from 1,500,000*l.* to 1,169,000*l.*, while on the other we are told that the grants to the universities this year will be no less than last and that the annual grants are to be maintained at their present scale. The real facts of the situation have become obscured by certain complexities, arising mainly from the difference between the Government financial year and the academic year, and from the exclusion this year of the Irish grants.

The first announcement of the Treasury's decision to reduce Government aid to university education was a simple one, to the effect that Parliament would be asked to vote for this purpose only 1,200,000*l.* instead of the million and a half voted last year. But the larger amount of last year included provision for Irish universities, amounting altogether to 111,000*l.* (not counting an emergency grant to Trinity College, Dublin), while this year the sum reserved in the estimates—namely, 1,169,000*l.*—makes no allowance for the Irish universities. The amount available for university education in Great Britain therefore falls, if the estimates are approved by parliament, from 1,389,000*l.* to 1,169,000*l.*—that is, by 220,000*l.*—the sum mentioned by the president of the Board of Education in his recent speech at Bristol.

The net reduction in the grant is happily less than was at first anticipated. But, even so, it is difficult at first sight to reconcile a loss of over 220,000*l.* with Mr. Fisher's remark to the effect that there would be

no real reduction of the amount of parliamentary money placed at the disposal of the universities this year. The explanation is to be found in the fact that the grants to the universities are made in respect of the academic year ending on July 31, while the parliamentary votes are for the year ending on March 31. Thus the grants for this present academic year are based on the parliamentary vote for the financial year which came to an end on March 31 last, and that was the year in which the vote was at its maximum. The grants for this academic year naturally show no reduction. On the contrary, they have increased because they are based on the increased vote.

The fall in the grants to universities will, of course, occur in the academic year ending in July 1923, and will be the direct and inevitable result of the reduction of the parliamentary vote for the financial year ending in March next. The reduction in the grants assigned to the various institutions in the financial year 1922–23 is seen to be no less than 113,905*l.*; but the loss in the academic year 1922–23 will be much greater than this, the difference being due to the fact that the amounts of grant shown in the estimates for 1921–22 are a good deal less than the sums actually received by the universities in the academic year 1921–22, being made up of three parts, namely:

(*a*) "Annual grant" for the second half of the academic year 1920–21 (before the vote had been increased by 500,000*l.*).

(*b*) "Annual grant" for the first half of the academic year 1921–22 (after the increase in the vote).

(*c*) What has been called a "non-recurrent grant," but might more correctly be termed a recurrent grant of variable amount.

It is obvious that, as the first of these three factors is based on the earlier low rate of grant, the total of the three will be considerably less than the aggregate of the grants received by the universities in the academic year 1921–22. Although exact figures are not available, there is reason to suppose that the actual fall in the academic year 1922–23, as compared with the present academic year, will be not far short of 250,000*l.*

If the smaller vote proposed for the current financial year is approved by Parliament, a large reduction in the university grants next academic year is a result which cannot be avoided. But even so, it may be urged, the universities will still receive considerably more than in 1920–21. This view, however, ignores two important considerations. First, the increase in the vote in 1921–22 was justified by the pressing need of the universities for additional aid, and the only reasonable ground for criticising it was that it was on too small a scale. Second, the increased vote encouraged the University Grants Committee to add to the grant list certain institutions—notably Oxford and Cambridge Universities and the clinical units of the London Medical Schools—which had not previously figured on the list. These new commitments, totalling approximately 120,000*l.*, undertaken on the strength of the enlarged vote, remain a permanent charge on the reduced vote.

The statement which has been made, and has given rise to some misconception, that the annual grants to the universities will be maintained at their present level, depends for its truth on what is little more, in fact, than a technicality.

In allocating to the universities the money voted by Parliament, the University Grants Committee has adopted the practice of giving only part of the money in the form of "annual grants" and the remainder (except what is kept in reserve) in the form of grants (called "non-recurrent"), the amount of which is decided in the case of each university each year. Whatever may be thought of this method of allocating the money voted by Parliament, and whatever these grants may be called, the fact remains that they have been made this year and in previous years, and that they will not be made next year. A reduction of a quarter of a million in the income of the universities is no less a reduction of a quarter of a million because the money lost has not been technically called an "annual grant." It must also be understood that it is not because the universities have not needed the whole of the money voted by Parliament that some of it has been treated by the "non-recurrent" method and some kept in reserve. The whole of the money, and much more than the whole of it, is sorely needed by the universities, and no amount of discrimination between grants of one denomination and grants of another denomination can alter the fact that the amount coming to the universities next year will be about a quarter of a million less than the amount received this year. Such a reduction must deal a very serious blow at the efficiency of university education in Great Britain.

The New Astronomy.

The New Heavens. By Prof. G. E. Hale. Pp. xv+88. (New York and London: C. Scribner's Sons, 1922.) 7*s.* 6*d.* net.

IT is impossible not to be impressed by the wonderful story of astronomical achievement told by Prof. Hale in felicitous language in this little volume. Before the invention of the telescope not more than about six thousand stars had ever been seen by human eyes, and less than half this number at any one time. The small telescope, with an object-glass an inch or

so in diameter, used by Galileo in 1610, brought within the range of vision stars down to magnitude 10·5, numbering about five hundred thousand. The 60-inch reflector of the Mount Wilson Observatory, Pasadena, of which Prof. Hale is director, reveals stars of the 18th magnitude, and the 100-inch carries the sounding-line still further, while with both instruments many stars can be photographed which the eye cannot see directly, the photographic limit with four or five hours' exposure being about the 20th magnitude.

The expansion of the stellar universe as regards the number of stars in it which can be seen or photographed represents, however, only a small part of modern astronomical discovery. The test of a telescope is its resolving power, and this is expressed with sufficient accuracy by the relation $5''/d$, where the numerator is the normal angular limit of separation of a double star and d is the diameter of the object-glass in inches. The separating power of the 36-inch refractor of the Lick Observatory is thus 0″·14, and that of the 100-inch of the Mount Wilson Observatory 0″·05. By the use of the interferometer, the latter limit is reduced to 0″·02, and this increase in resolving power was established by observations of Capella. More than twenty years ago, this star was found by Campbell and Newall to be a spectroscopic binary (that is, to consist of two stars in motion about a common centre of gravity and so close together that the system is known to be duplex only by detecting differences, due to orbital movement, exhibited by the composite spectrum), and determination of the orbit showed that the separation of the components could not exceed 0″·06. It was, therefore, within the theoretical limit of separation into its components by the use of Michelson's interferometer on the 100-inch telescope of the Mount Wilson Observatory. Observations made at the end of the year 1919 and the beginning of 1920 confirmed the accuracy of this conclusion, and the distance between the two stars of the pair was found on several occasions to be about 0″·045.

The capacity of the interference method was thus established by these observations with a test-object among the stars. Thirty years previously the method had been used to determine the diameters of Jupiter's chief satellites, but it was only when the 100-inch telescope had been completed that Prof. Hale suggested the application of the principle to the measurement of diameters of stars — a more difficult problem than that of separating close doubles. Prof. Eddington, in his presidential address to Section A of the British Association in 1920, gave the probable angular diameters of some stars and remarked that "the star with the greatest apparent diameter is almost certainly Betelgeuse, diameter 0″·051." Measurements with the 20-foot interferometer on December 13, 1920, gave an apparent diameter of 0″·047, which is as striking a confirmation of theoretical deduction by observed result as that represented by the discovery of the planet Neptune. The parallax of Betelgeuse is uncertain, but there are reasons for believing it to be about 0″·02, which would make the diameter of the star about 215,000,000 miles, or 250 times greater than the diameter of the sun. Antares has similarly been found to have a diameter of 400,000,000 miles and Arcturus of 21,000,000. These stars are in an early stage of stellar evolution—attenuated masses of matter low down on the ascending side of the temperature curve of Lockyer's meteoritic hypothesis—and from "giants" they will be transformed to "dwarfs" as they contract and increase in temperature.

Prof. Hale devotes particular attention to the various stages of growth and decay as indicated by modern studies of stellar types, and shows that they afford no direct evidence in favour of Laplace's theory of the formation of planets in our solar system. Recent investigations have truly revealed "The New Heavens," which he describes so clearly and illustrates so attractively with some of the most remarkable astronomical photographs ever obtained. In his last chapter, entitled "Cosmic Crucibles," he deals particularly with the sun as a star and some of the discoveries in the field opened by him by means of the spectroheliograph, which enabled him to prove that every large sun-spot is an electric vortex producing a magnetic field. As helium was discovered by Lockyer in the sun long before it was isolated on the earth, so in the laboratories of the heavens conditions are now continually being studied which not only enlarge our conceptions of the universe but also provide physicists and chemists with results of outstanding interest and value. No one is more competent than Prof. Hale to survey this great territory of which he is the leading pioneer explorer, and his account of the methods used to examine it and the rich store of new knowledge gathered from it, makes as fascinating a scientific story as ever was told. R. A. G.

Index Animalium.

Index Animalium. A Carolo Davies Sherborn. Sectio Secunda 1801–1850. Part 1: Introduction, Bibliography and Index A-Aff. Pp. cxxxi+128. (London: British Museum (Natural History), 1922.) 20*s*.

WE congratulate Mr. C. D. Sherborn on the appearance of the first instalment of the second part of his great work. Since the first part was published in 1902, zoologists have eagerly awaited its continuation,

and we hope that the remainder will now follow with all speed, for the real value of the work can be fully appreciated only in its complete form.

The second part follows closely the form and arrangement of the first. After an explanatory introduction there follows the bibliography, from which the stupendous nature of the task which has occupied the best thirty-one years of Mr. Sherborn's life can be judged. One hundred and thirty-one pages of closely printed matter in small type are required to give the titles of the publications which the author has indexed. Against this, less than two pages of similar type, giving the publications to which the author has not had access (some of these have been seen since the list was set up in print) represent an almost negligible part of zoological literature that has not passed through his hands.

When it is remembered that, but for some 5000 entries made for the author by friends, the whole of the literature has been examined and every entry in the index recorded from the original, arranged, sorted, checked and passed for press by Mr. Sherborn himself, we begin to realise something of the debt which zoology, now and for all time, owes to the author. The personal equation has been reduced to a minimum, and Mr. Sherborn's accuracy, which has stood the severe test of the first part of this index, is a guarantee of the absolute reliance which can be placed on the second part. The author has given valuable bibliographical notes to the literature he has examined, and has smoothed the path of systematic zoologists considerably by indicating where that literature is to be found in England and whether it contains new names or any information likely to be of use.

The "Index Animalium" should henceforth be regarded as the bible of systematic zoology. It seems to us that all the vexed questions of nomenclature and priority could be settled by a reference to its pages, and the time and labours of systematists freed for the more complete examinations of the animals themselves. Acknowledgments are due to the Committee of the British Association and to the Trustees of the British Museum for the financial assistance they have given to this work, and to the latter body for assuming the responsibilities of publication. It is only fitting and proper that the most important centre of systematic zoology in the world should undertake the issue of this invaluable and indispensable work, and we are grateful to the Trustees of the British Museum for having done so.

A word of praise is due, too, to the printers and publishers for the admirable way in which this instalment has been printed and for its freedom from errors. We have detected no typographical mistakes in a fairly close scrutiny. Sir Sidney Harmer in his preface refers to the index as a "labour of love," and we can but inadequately express our thanks to Mr. Sherborn for his magnificent and untiring work. We may, perhaps, be allowed to express our pleasure in the fact that publication is assured and that the results of Mr. Sherborn's work will be preserved in permanent form as a splendid monument to his labours in the cause of science.

Sugar Technology.

(1) *Cane Sugar: A Textbook on the Agriculture of the Sugar Cane. The Manufacture of Cane Sugar, and the Analysis of Sugar-house Products.* By Noël Deerr. Second (revised and enlarged) edition. Pp. viii+644+xxix plates. (London: Norman Rodger, 1921.) 42*s.* net.

(2) *The Manufacture of Cane Sugar.* By Llewellyn Jones and Fredric I. Scard. Second revised edition. Pp. xix+481+270 plates. (London: Duckworth and Co., 1921.) 25*s.* net.

(3) *Condensed Description of the Manufacture of Beet Sugar.* By Dr. F. Murke. Pp. v+175. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1921.) 15*s.* net.

(1) BEARING in mind the importance of the sugar industry to the British Empire, more especially in its relation to sugar cane, it is not surprising, and distinctly comforting, to know that we are so well supplied at the present time with up-to-date literature on the subject. Mr. Deerr's treatise ranks among the most important, occupying as it has done for the last ten years—and if we include his first smaller work we may say seventeen years, not to mention his "Sugar House Control" published in 1900—a unique position, the subject being treated from both the theoretical and practical standpoints. The long experience of the author as a technologist and an experimentalist had qualified him eminently for the task he undertook, while for the past ten years he has added still further to his previous extensive experience by being associated with the sugar industry in Cuba and with a sugar refinery in New York. The first edition of Mr. Deerr's treatise was published in 1911. The present edition covers 52 additional pages, each containing some 11 per cent. more words, in addition to which it has been completely rewritten. The reputation of the author is so well known and generally admitted that it is a guarantee at once that his task has been carried out with thoroughness. It is worthy of note, however, that his MS. has been submitted to the following authorities, to whom he acknowledges his thanks for help and criticism: Mr.

J. Hamill, Dr. C. A. Browne, Dr. C. A. Barber, Dr. E. J. Butler, and Mr. J. P. Ogilvie.

It is impossible to deal in detail with such a voluminous work as the one before us; it must suffice therefore to point out that it deals with all phases of the subject—botanical, agricultural, chemical, and technological.

We cordially recommend the volume to all engaged in the sugar industry, as well as to students who intend entering that industry.

(2) The first edition of Messrs. Jones and Scard's treatise was published in 1909, and the fact that a second edition has now appeared is a fitting testimonial, if one were needed by two such eminent and well-known technologists, of its utility as well as of its appreciation by technologists. Mr. Aspinall in the introductory chapter tells us that the first impression of the work was soon sold, and that the authors preferred to prepare a new and revised edition instead of issuing at once a reprint of the first edition.

The work as now presented is in its original form, but it has been thoroughly revised with some 27 additional pages of text and 26 further illustrations. The volume is a welcome addition to the literature, more especially from the technological point of view. A special feature is the large number of well-executed drawings and plans, numbering in all 270, for which the authors are indebted to the leading engineering firms.

The work will be found indispensable to all engaged in the industry, and we welcome its appearance at a time when it behoves sugar-cane technologists, more especially in the British Dominions, Dependencies, and Protectorates, to cultivate the highest efficiency in their subject, and so make the Empire self-supporting as regards sugar. This is a matter which in the writer's personal knowledge one of the authors at least, Mr. F. I. Scard, has long had at heart.

(3) Dr. Murke's little book was written in 1903–5, but was not published. Recently the author found that it could be brought up to date with very few alterations and additions. While it contains much valuable information, the text is of a sketchy character, the sequence is not well chosen, and some important processes find no mention. This being so, it is scarcely to be recommended as an elementary textbook on the subject. However, the author states that it has been written for "superintendents, engineers, and foremen of the beet sugar factory," and such readers would doubtless be able to follow the text without the aid of illustrations, of which there are none.

If we may be allowed to make a few comments, we would point out that while a concise account is given of Stephan's process of recovering sugar as calcium trisaccharate from molasses, no mention is made that the trisaccharate may be used instead of fresh lime for defecating beet juice. We should have expected to find some reference to the strontium process, but the chapter on the osmose process was scarcely needed; indeed the author himself states that it is almost exclusively an historical one. Most English technologists will prefer the French word "massecuite" instead of "fillmass," the translation of the German "Füllmasse."

Now that we have at least two beet sugar factories at work in the United Kingdom, the demand for works on the subject has naturally increased.

ARTHUR R. LING.

Geology and Tin Resources of the British Empire.

(1) *The Geology of the British Empire.* By Dr. F. R. C. Reed. Pp. viii+480. (London: Edward Arnold, 1921.) 40*s.* net.

(2) *The Tin Resources of the British Empire.* By N. M. Penzer. (*The Raw Materials of Industry.*) Pp. x+358. (London: William Rider and Son, Ltd., 1921.) 15*s.* net.

THE geology of our overseas dominions has been described in a host of publications, many of which are difficult of access and full of local and technical detail. A compact volume, such as the one under notice, in which the outstanding facts concerning the several regions are presented in brief but readable form, cannot fail to meet with a warm welcome. It will appeal not only to students faced with the difficult task of acquiring a general knowledge of world stratigraphy, but also to all who wish to know the larger geological facts of our Empire abroad.

The subject-matter is based upon a course of lectures which the author has given annually for more than a decade. It has not been hastily compiled, therefore, but is the result of many years of wide reading and judicious condensation. Only those who have tried to assemble within a small compass the salient information concerning the geology of countries like Canada, India, or South Africa will be able to gauge the extent of the author's labours or to thank him adequately for placing the results of them at the disposal of the public.

No description is given of the geology of the British Isles, numerous works on this subject being available. The first region dealt with is the Mediterranean, including Gibraltar, Malta, and Cyprus. Egypt follows, reminding us of the rapidity of Empire changes in these days of awakened national aspirations. In the next chapter, dealing with East Africa, an account is given of the geology of Somaliland, Kenya Colony,

and Tanganyika Territory. Then follow two chapters containing a most useful summary of the geology of the Union of South Africa. Central and South-West Africa and British West Africa are dealt with in the two succeeding chapters, the latter including some pages devoted to the British Cameroons and Togoland. Canada and Newfoundland are dealt with in two chapters occupying sixty pages, and the Indian Empire in two of sixty-six pages. These are admirable summaries, which are especially welcome in view of the importance and interest of the work which has been done in these lands and of the great volume of literature that has been epitomised. The Malay States, British Borneo, the Indian Ocean islands, and Hong Kong are treated in a chapter on the East Indies. Then come two chapters on the geology of Australia, one on New Zealand, and one on Oceania, some account being included in the last of territory acquired since the war. The last chapter, under the title of the Mandatory Regions, deals with Mesopotamia and Palestine.

In most cases the descriptions of the several regions are accompanied by sections and folding geological maps in black and white. These are printed on good paper, and students would derive considerable benefit in tinting them with washes of colour. In connection with each area a useful bibliography is also given, which, by referring readers to further sources of information, adds greatly to the value of the book.

Both author and publisher are to be congratulated upon having produced an important and most useful addition to British geological text-books.

(2) Mr. Penzer's book is of a more specialised kind. It is the second of a series devoted to the raw materials of industry, the first of which dealt with cotton and wool throughout the world. This second volume restricts itself to tin within the Empire, which, constituting two-thirds of the world's supply, provides ample material for a single volume. It is proposed to issue later another volume describing the extra-British sources of the metal.

The introduction deals with the history of tin production and with the tin-bearing minerals. Then there are four chapters describing the various fields, arranged according to continents; this part of the book contains much detailed information, and is illustrated by a number of specially drawn distribution maps. There is also a chapter on the industrial applications of tin, and one giving statistics as to output, prices, and conditions of sale. The volume closes with an elaborate classified bibliography.

A perusal of this book has left the impression that its writer has been assembling information upon a subject which is outside the limits of his own practical experience. This impression detracts a little from the authority of the work, but it must not be allowed to obscure the fact of the author's remarkable industry or of the extraordinary amount of information which he has gathered together into the 350 pages of his book. By indefatigable labour he has made a valuable compilation which many interested in the mineral industries will be glad to possess and keep by them for purposes of reference. C. G. C.

Our Bookshelf.

The Vitamins. By Prof. H. C. Sherman and S. L. Smith. (American Chemical Society: Monograph Series.) Pp. iii+273. (New York: Chemical Catalog Co., Inc., 1922.) 4 dollars.

A VERY welcome addition to the literature of vitamins has been provided by Prof. Sherman and Mr. S. L. Smith in the volume under notice. The plan of the book is very simple; an historical introduction is followed by three chapters devoted to the three generally recognised vitamins and a final chapter is added on the relation of these important principles to the problem of food supply. A bibliography is also given, which comprises about a thousand entries and includes the literature so far as the end of 1921.

The treatment of the subject is throughout clear and critical, and the authors err if at all on the side of caution. Thus they do not regard the identity of the water-soluble and antineuritic vitamins as proved, but consider that "the preponderance of evidence thus far available favours the view that the water-soluble, growth-promoting vitamin is probably among the substances which may exert antineuritic action." They display a similarly open mind as to the vexed questions of the nature of vitamin B and its relation to the growth of yeast, which are both being actively investigated, with tantalisingly varied results, in many laboratories. The concluding chapter will probably be found the most interesting by the non-specialised reader, as in it the authors discuss the commonly used foodstuffs from a general point of view, devoting attention to their special merits or demerits, not only as carriers of vitamins but as sources of "good" or "bad" proteins and of energy. Their final conclusion brings comfort to those who are anxious as to the suitability of their everyday diet: ". . . we believe it safe to say that with a dietary selected to make the best use of our ordinary staple foods there will rarely if ever be occasion to purchase vitamins in any other form, or to give any greater anxiety to the vitamins than to some other factors which enter into our present conception of nutritive requirements and food values."

Essai philosophique sur les probabilités. Par Pierre-Simon Laplace. (Les Maîtres de la Pensée Scientifique: Collection de mémoires et ouvrages. Publiée par les soins de Maurice Solovine.) I. Pp. xii+103. II. Pp. iv+108. (Paris: Gauthier-Villars et Cie, 1921.) Each vol. 3 francs net.

OUR students spend little or no time in the study of the classical documents of scientific discovery. This neglect is very much to be regretted, for there can be

no doubt that nothing is so inspiring and fascinating as the perusal of the account of a great discovery by the discoverer himself. The personal element, so conspicuously absent in current textbooks, is in this way given its opportunity, especially if the discoverer's account is read in the original language in which it was written. The series now being issued under the editorship of M. Solovine is therefore to be welcomed.

The present essay was first printed as an introduction to Laplace's "Théorie analytique des probabilités." It gives in non-mathematical language the principles underlying Laplace's methods for dealing with the theory of probability, and shows how it is applied to problems of natural science — especially the astronomical problems to which Laplace applied his genius—to sociology and other aspects of communal life. Special attention is devoted to errors in the estimation of probabilities, due to psychological causes, and there is also a brief history of the methods of probability.

Considerable modification has since been introduced into the fundamental notion of probability, but Laplace's essay should be read by all students of mathematics. In it occurs the sentence: "Une intelligence qui pour un instant donné connaîtrait toutes les forces dont la nature est animée et la situation respective des êtres qui la composent, si d'ailleurs elle était assez vaste pour soumettre ces données à l'analyse, embrasserait dans la même formule les mouvements des plus grands corps de l'univers et ceux du plus léger atome: rien ne serait incertain pour elle, et l'avenir comme le passé serait présent à ses yeux." S. BRODETSKY.

Displacement Interferometry applied to Acoustics and to Gravitation. By Prof. Carl Barus. Pp. viii+149. Publication 310. (Washington: Smithsonian Institution of Washington, 1921.)

PROF. BARUS' work is divided into twelve chapters, and occupies an intermediate position between the usual textbook dealing with routine work and the ordinary type of original research which attacks and solves some specific and definite problem. It is throughout of an exploring nature and may be said to investigate the suitability of interferometry as a method for research in various branches of acoustics and gravitation. In the first chapter the open mercury manometer, when read by interference, is discussed. In the second, the interferometer U-tube is used as an absolute electrometer. The third deals with acoustic pressures, the fifth treats of the compression of a sound wave in a pipe, and the sixth with the vibration of a telephone plate. In the eighth and following chapters various gravitational problems are approached. The book is a storehouse of unusual experimental methods and may be consulted with advantage by any one about to commence investigations along the lines indicated.

Publications of the Washburn Observatory of the University of Wisconsin. Vol. X. Part 4: *Observations of Double Stars*, 1907–1919. By George C. Comstock. Pp. 167. (Madison, Wis.: Washburn Observatory, n.d.)

THE volume under notice forms a catalogue of all the observations of double stars made with the 16-inch refractor at Washburn Observatory by Prof. Comstock between 1907 and 1919; summaries of his earlier observations with the same instrument from 1889 to 1907 are also given, so that it is possible to detect changes. There are some 200 stars in the catalogue, including most of the well-known binaries.

The probable errors are given as 2°·6, 0″·03 for separations less than 0″·5, and 0°·9, 0″·07 for those between 2″ and 4″. Wires illuminated by red light were employed. This involves the possibility of small errors through unequal refraction of the images of wire and star in the eyepiece, unless the latter is achromatic. A list is given of the eyepieces, which are either Ramsden or Kellner, with powers varying from 196 to 1540; about 800 was commonly used. A. C. D. C.

Drugs in Commerce: Their Source, Preparation for the Market, and Description. By J. Humphrey. (Pitman's Common Commodities and Industries.) Pp. xi+116. (London: Sir Isaac Pitman and Sons, Ltd., n.d.) 3*s*. net.

MR. HUMPHREY has contrived to include within the moderate compass of 113 pages of text a good account of the drugs of natural origin found in commerce. The information given includes descriptions of the drugs, notes on their constituents and sources of supply, and in most cases some particulars as to their modes of preparation for the market. Great pains have evidently been taken to secure accuracy, but it should have been pointed out that the "henbane" imported from Egypt is not derived from *Hyoscyamus niger*.

The book contains six plates illustrating the more important drugs, *e.g.* cinchona, ergot, opium, and jaborandi, and six more showing scenes in drug warehouses at the London Docks and methods of packing and selecting the spices, such as nutmeg and cinnamon, used in medicine. The book can be cordially recommended to any one desirous of obtaining general information regarding this interesting and little-known group of commercial products.

Memoirs of the Geological Survey: England and Wales. The Water Supply of Cambridgeshire, Huntingdonshire, and Rutland from Underground Sources. By W. Whitaker. Pp. iv+157. (Southampton: Ordnance Survey Office; London: E. Stanford, Ltd., 1922.) 7*s*. net.

THE latest addition to the series on the underground water supplies of England deals with three counties which form a convenient unit. The counties being agricultural rather than industrial or manufacturing, very large water supplies are required in few cases. Supplies are obtained chiefly by means of wells, but some water is obtained from springs, notably the supply of the town of Wisbech, which, however, obtains its water from the county of Norfolk. At least one town of more than 5000 inhabitants seems to have no public supply. Chalk and, to a less extent, lower greensand are the sources of water in these counties. The Oolites and Lias are also of some importance. The value of chalk in this respect in the south-east of England corresponds with that of New Red sandstone in the Midlands. In addition to full details of the wells and springs in the three counties Mr. Whitaker gives some useful indications as regards enlarging and improving existing supplies.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Stature of the Scottish People.

ON the data published in the "Final Report of the Anthropometric Committee" of the British Association (1883), the Scottish people have been regarded as being considerably taller than any other British nationality. The following letter from Dr. Aleš Hrdlička, of the United States National Museum, Washington, D.C., shows that, through an error in computation, the Scots have had nearly two-thirds of an inch added to their real stature.

"In preparing my report on the 'Stature of the Old Americans' I had occasion to look up, among other things, the principal records of that nature on the Scotch people. I found quite a number of these and they all showed fairly harmonious results, with one exception. This was the record on the Scotchmen in the 'Final Report of the Anthropometric Committee' of the B.A.A.S., 1883, p. 256. This record gave results that were so much higher than any others that I was finally led to a re-computation of the series. Taking the number of persons measured and the record in inches, in which the measurements were originally recorded, I found to my surprise a different and a very perceptibly lower average. The averages given in the Report were 68·71 in. or 174·6 cm., while I obtained 68·1 in. or 172·97 cm.

"I should be thankful to you if you would bring this matter to the attention of the members of the Anthropological Institute, and have it looked into; and if it should be found that an error has been made, then I think it would be advisable for some one to publish a little note on the subject, for the figures of the Anthropometric Committee have been widely utilised (see Deniker, Martin, etc.)."

I have not checked Dr. Hrdlička's estimates, but I have no doubt that they are right. The average stature of the four British nationalities thus amended reads: Scottish, 172·9 cm.; Irish, 172·6 cm.; English, 171·2 cm.; Welsh, 169·4 cm.

ARTHUR KEITH.

Advanced Mathematical Study and Research at Cambridge.

IT has been suggested to me that attention might well be directed through the columns of NATURE to a point in the regulations of the University of Cambridge which prevents many graduates of other universities taking advantage of the opportunities Cambridge offers for advanced mathematical study.

In most universities other than Cambridge our best students of mathematics now usually read for a degree in science. They have passed an entrance examination of a standard far higher, I need scarcely say, than that of the Previous Examination. But neither in their entrance examination nor in their course need they have taken Latin or Greek. They are thus cut off from the privileges of affiliation, which include exemption from the Previous Examination and permission to take their degree on Part II. of the Tripos after a residence of two years.

It is true that graduates of other universities may proceed to the degrees of M.Sc. and Ph.D. at Cambridge by research, without any questions being asked as to the nature of their entrance examination. But in my opinion, at least, few of the graduates of the Scotch universities, the newer English universities, and the universities of the Dominions are ready to devote themselves to research in mathematics immediately after graduation. What they want at that stage is just such advanced instruction as Cambridge now offers in the subjects of Schedule B of Part II. of the Tripos. They should be able to take the Part II. examination easily after six terms. Before the end of that time they may have begun some research. But the man who wishes to become a professional mathematician should continue research work for at least two years after taking Part II. Some of the time would be spent at Cambridge; and one or other of the great schools of mathematics at Paris, Rome, Berlin, or Göttingen should certainly be visited.

Oxford admits to the status of Senior Student any person who has obtained a degree at an approved university after a three-year course, the degree also having been approved by the Hebdomadal Council. If Cambridge would modify its regulations for admission to the privileges of affiliation so that our best graduates in mathematics could take the Cambridge B.A. on Part II. after six terms, I believe its school of mathematics would receive a larger number of brilliant scholars, and there would be more of our mathematicians at home and abroad engaged in research.

H. S. CARSLAW.

The University, Sydney, May 1.

Condition of Electrolytes in the Blood.

ARE the salts present in the blood ionised to an equal extent as similar concentrations of these salts in aqueous solution? Are the ions absorbed by the protein? These are questions that have been attracting the attention of physiologists and biological chemists. Investigators have attempted to answer these questions principally by two methods—compensatory dialysis of the serum (Rona, Michealis, and their co-workers) or filtration with pressure (Starling, Cushny, Richter-Quittner).

It seemed worth while to determine the concentrations of other ions by electromotive force measurements, as is done in the case of the hydrogen ion. Accordingly, a 0·2 per cent. sodium amalgam that is but slowly decomposed was used as a sodium electrode. After measuring the E.M.F. of this electrode against known concentrations of sodium chloride of known degree of ionisation, the normal potential of this amalgam electrode was obtained. The E.M.F. of samples of serum and plasma were then measured. When from these readings the total concentrations of Na present were recalculated on the basis that the degree of ionisation of the sodium salts was the same as in an aqueous solution, the calculated Na concentration and that found by analysis were in very good agreement. For example in two samples the calculated values of sodium were 3·51 and 3·67 grams; the values found were 3·46 and 3·65 grams per litre. Thus the conclusions of the aforementioned workers that Na is not bound in the serum, because it can be dialysed and filtered *in toto*, has been confirmed.

To determine the concentration of Cl-ions, an Ag/AgCl electrode was used. By calculations similar to those outlined in the case of sodium, it was found that the quantities of Cl present calculated from E.M.F. measurements of serum and plasma, on the assumption that we were dealing with an aqueous

solution of sodium chloride, were in good agreement with those found by analysis. Thus in two samples, for example, the totals for chlorine calculated as NaCl were 6·443 and 6·541; the totals found were 6·535 and 6·61 grams. Chlorine likewise is apparently as free as in an aqueous solution.

The writer is at present developing a calcium electrode to determine the state of calcium in the blood.

BENJAMIN S. NEUHAUSEN.
Johns Hopkins University, Baltimore, Maryland.

The Dimensions of Area.

IN my "Physics," pp. 423-426, it is maintained that it is incorrect to attribute to area (or volume) the dimensions L^2 (or L^3); but no example of an error arising from such attribution could be given. It has since occurred to me that an excellent and important example is provided by Child's high vacuum current law, according to which σ, the current density, is proportional to $\left(\frac{e}{m}\right)^{\frac{1}{2}} \frac{V^{\frac{3}{2}}}{l^2}$.

The laws assumed in the deduction of this relation are (1) $\frac{V}{l} . A = \alpha . e$ (Poisson's equation), (2) $\sigma . l . A = \beta . e . v$, (3) $m . v^2 = \gamma . e . V$, where A and v are area and velocity, and α, β, γ formal constants or no-dimensional magnitudes. If in place of A we write l^2, we find that $\sigma^2 l^3 m \left(\frac{l}{e}\right)^n V^{n-4}$ is no-dimensional for all values of n. The solution is ambiguous and the Child relation is not deducible by dimensional argument, as it clearly ought to be. If, on the other hand, we retain A, $\sigma^2 l^4 \left(\frac{m}{e}\right) V^{-3}$ is the only no-dimensional magnitude independent of A and v; we obtain a unique and correct result.

The removal of the ambiguity must be due to the introduction of some additional law. This additional law is that the ratio of the area in (1) to the area in (2) is independent of l, or that l is perpendicular to A in both cases, or that the electrons follow the lines of force. If we omit the important magnitude shape in stating the dimensions of A, this law cannot be introduced into the dimensional argument, because there remains no magnitude to measure direction.

The additional law is not quite strictly true because of the inertia of the electrons. It follows, therefore, that if the electrodes are arranged so that the curvature of the lines of force is very great, small departures from the Child relation are to be anticipated. But so long as the curvature is small, the relation will hold if the systems compared are geometrically similar, differing only in their size l. So far as I know, the relation has hitherto been proved only for parallel plane and concentric cylindrical electrodes; experimentally it is known to be true over a much wider range.

NORMAN R. CAMPBELL.
19 Holland Park, W.11, June 4.

The Resonance Theory of Hearing.

MR. ACKERMANN (NATURE, May 20, p. 649) is probably correct when he states that the first incoming sound wave sets all the resonators of the ear temporarily in vibration, and also, that as the sound waves continue the vibrating resonators decrease in number until only those are left in motion that are executing either sympathetic or forced vibration in time with the incoming sound waves. But surely he has left out of account the probable amplitude of the motion performed by the resonators, and the probable physiological properties of the mechanism, when he judges the intensity of the sound stimuli sent along the auditory nerve to the brain to be directly proportional to the number of resonators that are swinging at any moment?

At the present time we have practically no information concerning the type of response given by the auditory nerve. It may, like certain motor nerve fibres, obey the all-or-nothing law, or it may conduct with a decrement, or it may be graded in its response. But in all these cases the amplitude will be an important factor in deciding the response given by any one hair cell and nerve fibre. But there are, I think, other physiological factors which Mr. Ackermann has overlooked. For although we cannot directly stimulate the hair cells of the cochlea electrically and ascertain the approximate relationship between strength of stimulus and strength of response, so that we can demonstrate clearly that the auditory mechanisms have such physiological properties as threshold, latent period, simultaneous and successive contrast (as we can, for example, in the case of the skin end organs), yet we have sufficient evidence that these properties are exhibited also by the auditory mechanism as by the other organs of special sense. Reconsidering now the case that Mr. Ackermann has taken, and assuming as a basis for calculation—

(*a*) that the sound wave energy entering the ear in unit time is constant;
(*b*) that the pitch is constant;
(*c*) that the mean amplitude of all the resonators in vibration at any one time is inversely proportional to the number in vibration; and
(*d*) that the energy available for distribution is proportional to the length of time during which the sound waves have been arriving, *i.e.* that none of the energy entering the cochlea has been lost in eddies, friction, etc.;

the following table shows the number of oscillators in vibration and their mean amplitude:

No. of Sound Waves from Common Cement.	No. of Resonators in Vibration.	Mean Amplitude.
1	6000	·003
2	1000	·03
3	600	·08
4	450	·13
5	350	·21
6	290	·31
7	240	·44
8	200	·60
9	170	·80
10	150	1·00

It will be seen that after one sound wave 6000 resonators are in vibration with an amplitude of 0·003, whereas after 10 sound waves 150 resonators only are swinging with an amplitude of 1. The table shows that there is a rapid increase in the mean amplitude of the vibrating resonators at the commencement of a tone.

There is no pretence of any exactness in the above values. They merely illustrate the kind of results to be expected. It should be noted further that at any instant those resonators approximately "in tune" with the incoming sound waves will have amplitudes considerably greater than the mean value, others nearest to those which are coming to rest will have amplitudes less than the mean value.

Therefore, even after one complete sound wave there will be already a clearly marked selection of the "in-tune" group of resonators.

Taking now the physiological effects into consideration, the threshold factor will definitely rule out all amplitudes below a certain value, so that after a certain number of sound waves have entered the ear the amplitude of the "in-tune" resonators will be the first to rise above the threshold and will cause impulses to pass up the auditory nerve. A little later a larger number of resonators will have reached amplitudes above the threshold, so that there should be a gradual increase in the number of resonators in active response, until the full steady value is reached. Calculation shows that the "in-tune" resonator should attain 90 per cent. of its final amplitude in eight vibrations. On the resonance theory one would therefore expect a gradual rise in the sound intensity occurring in a time interval of the order of 10-20 vibrations of the incoming sound waves (*i.e.* 1/25-1/12 sec. for middle C), and not a fall as Mr. Ackermann has suggested in his letter. It would seem that this effect is responsible for the absence of roughness at the commencement of a tone due to the imperception of the transient vibrations of "out-of-tune" resonators.

Now if the rise of sound intensity is a gradual one, what, it may be asked, is the mode of perception of a tone which starts with large amplitude and gradually diminishes as it goes on—*e.g.* a piano note? In such a case it would seem that after a very few vibrations, the swings of the resonators must reach such an amplitude that their motion is perceived. In this case, then, the vibration of "out-of-tune" resonators makes itself perceived because the auditory nerve fibres are taking up responses before there have been sufficient incoming sound waves to damp out the "out-of-tune" resonators. It would seem to be this effect which gives the transient harshness to the commencement of a piano note, causing it to sound to the ear as if it started with a consonant.

H. HARTRIDGE.

King's College, Cambridge.

An Experimental Towing-tank used by Benjamin Franklin.

IN the "Calendar of Industrial Pioneers" in NATURE, May 6, p. 598, relative to the anniversary of William Froude, your correspondent says: "His (Froude) work led to the construction by the Admiralty of the experimental tank at Torquay, the first of its kind ever built."

It will be doubtless interesting to readers of NATURE to have it brought to their attention that Benjamin Franklin in his many and varied investigations in philosophical subjects investigated, to some extent, the difference of navigation in shoal and deep water. In a letter written to Dr. John Pringle, May 10, 1768, he gives the results of experiments made along these lines. The letter tells of how, during a trip with Dr. Pringle in Holland, it was brought to their attention that the *treckschuyt* in one of its trips went slower than usual, due, as the boatmen explained, to the water in the canal being low. After his return to England, not being entirely satisfied with the boatman's explanation, Franklin questioned the Thames river watermen and found them all agreeing as to fact, but differing widely in expressing the quantity of the difference. He, therefore, designed the following experiment, which in its nature is a forerunner of the modern towing-tank. I quote from his letter:

"I provided a trough of planed boards fourteen feet long, six inches wide, and six inches deep in the clear, filled with water within half an inch of the edge, to represent a canal. I had a loose board, of nearly the same length and breadth, that, being put into the water, might be sunk to any depth, and fixed by little wedges where I would choose to have it stay, in order to make different depths of water, leaving the surface at the same height with regard to the sides of the trough. I had a little boat in form of a lighter or boat of burden, six inches long, two inches and a quarter wide, and one inch and a quarter deep. When swimming, it drew one inch water. To give motion to the boat, I fixed one end of a long silk thread to its bow, just even with the water's edge; the other end passed over a well-made brass pulley of about an inch diameter, turning freely on a small axis; and a shilling was the weight. Then, placing the boat at one end of the trough, the weight would draw it through the water to the other.

"Not having a watch that shows seconds, in order to measure the time taken up by the boat in passing from end to end, I counted as fast as I could count to ten repeatedly, keeping an account of the number of tens on my fingers. And as much as possible to correct any little inequalities in my counting, I repeated the experiment a number of times at each depth of water, that I might take the medium. And the following are the results:

	Water. 1½ inches deep.	2 inches.	4½ inches.
1st exp.	100	94	79
2nd ,,	104	93	78
3rd ,,	104	91	77
4th ,,	106	87	79
5th ,,	100	88	79
6th ,,	99	86	80
7th ,,	100	90	79
8th ,,	100	88	81
	813	717	632
	Medium 101	Medium 89	Medium 79

PAUL C. WHITNEY.

U.S. Coast and Geodetic Survey,
Washington, D.C., May 22.

An Experimental Confirmation of the Kinetic and Molecular Theories of Magnetism.

CURIE'S law states that ferromagnetics above the critical temperature behave in such a way that the susceptibility (k) is inversely proportional to the absolute temperature (T), in short, that the product $k \cdot T$ is a constant. The physical meaning of this law is that when the molecular magnets have complete freedom of rotational movements, the energy of magnetisation is then only opposed by the energy of thermal agitation and, consequently, any given state is a state of equilibrium.

Below the critical temperature complications introduced by the mutual magnetic actions of the molecules, one on the other, and by the approach to a saturation limit have obscured any such simple law. It is, however, possible to eliminate, or allow for, the effects of these disturbing factors and to make experiments, under hysteresis-free conditions, upon the variation of susceptibility with temperature. Experiments of this kind have been carried out on

iron and nickel, and the reduction of the observations has now been completed, with the result that the Curie law, with certain limitations, is found to apply to the ferromagnetic state, and the relation $k.T$ = a constant is approximately satisfied, but the constant now is of a very different magnitude from the former one. There is, however, this simple and important relation between the constants in the two states—their ratio is *the kinetic energy per unit of temperature per gram of two degrees of freedom*, and is thus immediately connected with the gas constant R. This result is of importance because it shows that the change from the ferromagnetic to the paramagnetic state is quantitatively explicable as due to the acquisition of the kinetic energy per unit temperature required for the two degrees of rotational freedom which are effective in controlling magnetic susceptibility.

Thus there is proof from magnetic data alone, independently of thermal data, that the change at the critical temperature from ferro- to paramagnetism is due to the gain of energy associated with two degrees of freedom.

This acquisition of energy-content makes itself evident in the increase of specific heat which ferromagnetics show at and above the critical temperature, and is quantitatively in agreement with the magnetic result.

It is no longer necessary now to assume, as has been done, that an immense intrinsic *magnetic* field is the cause of ferromagnetism, although it may be convenient to introduce a fictitious magnetic field such that it will give rise to energy effects equivalent to the energy of two degrees of freedom.

The results which have been discussed above are also a confirmation of the simple view advanced by Ewing in his earlier papers on the molecular theory of magnetism, in which he suggests that the loss of ferromagnetic qualities may be caused by the oscillations of the molecular magnets which become wider and wider up to the critical temperature, at which point they pass from vibration to rotation.

J. R. ASHWORTH.

May 30.

Molecular Ælotropy in Liquids.

A VERY remarkable feature shown by many liquids in experiments on the molecular scattering of light is that the scattered beam in a direction transverse to the primary rays shows a large admixture of *unpolarised* light, the proportion of this to polarised light in the scattered beam being several times greater than in the case of the same substance in the condition of vapour at atmospheric pressure. This fact seemed at first very puzzling; an explanation is, however, now forthcoming. A theory of the phenomenon has been worked out by the writer which not only explains the facts in a simple and quantitative manner, but has also pointed out the way to further fruitful research. It may be briefly indicated as follows:

The polarised and unpolarised parts of molecularly scattered light may be conceived as arising in two distinct ways; the former is a *mass-effect* arising from the thermal fluctuations of density in the fluid, and its magnitude is given by the Einstein-Smoluchowski formula

$$\frac{\pi^2}{18} \cdot \frac{RT\beta}{N\lambda^4} \cdot (\mu^2-1)^2(\mu^2+2)^2,$$

and as we pass from the condition of vapour to that of liquid in which the molecules are more closely packed together, it increases much less than in proportion to the increased density. The *unpolarised* part of the scattered light is, on the other hand, a *molecular* effect, and its magnitude increases simply in proportion to the number of molecules per unit volume. The ratio of unpolarised to polarised part of the scattered light should therefore be considerably enhanced. This is exactly what is observed. If I_1 and $2I_2$ are respectively the polarised and unpolarised parts of the transversely scattered light, the ratio $I_2/(I_1+I_2)$ may be determined experimentally by analysis with the aid of a double-image prism and a nicol. The Table below shows in the second column the value of this ratio as determined by Lord Rayleigh for certain substances in the state of vapour, in the third column the value of the ratio for the liquid state at ordinary temperature as calculated from the writer's theory, and in the fourth column the value as determined by Mr. K. Seshagiri Rao in the present writer's laboratory. The agreement is significant.

RATIO OF COMPONENTS OF POLARISATION

Substance.	Observed, Vapour.	Calculated, Liquid.	Observed, Liquid.
	Per cent.	Per cent.	Per cent.
Ethyl Ether . .	1·7	10·9	8·2
Benzene . . .	6·0	39·8	39·8
Chloroform . .	3·0	18·2	15·5

We may also view the matter in another way. When a substance is in the state of vapour under small pressures, both the positions and orientations of its molecules are absolutely at random, and assuming the molecules to be ælotropic, the degree of imperfection of polarisation of the light scattered by it may easily be calculated, as has been done by the late Lord Rayleigh. On the other hand, in the liquid state, the packing of the molecules is so close that their ordering in space is no longer at random; but we may still, at least in the case of ordinary liquids, consider the orientations to be arbitrary without serious error. If we take this into account in determining the resultant effect of the waves scattered by the individual molecules, we should be led to the same result as has been indicated above.

The theory put forward has other notable successes to its credit. The Einstein-Smoluchowski formula indicates that though the density of a liquid diminishes with rise of temperature, its scattering power should increase and become very large as the critical temperature is approached. Similarly, as the temperature is increased, the scattering power of the saturated vapour should increase much more rapidly than in proportion to its density. Accordingly, in both cases, we should expect the polarisation of the scattered light to improve steadily with rise of temperature and become practically complete as the critical temperature of the liquid is approached. Experiments with benzene liquid and vapour made by Mr. K. R. Ramanathan have quantitatively confirmed this prediction. A similar improvement in polarisation has also been observed by Mr. V. S. Tamma in experiments on the scattering of light in *binary liquid mixtures* as the critical temperature for separation into two phases is approached.

C. V. RAMAN.

210 Bowbazar Street, Calcutta,
May 11, 1922.

Recent Investigations of the Lake Dwellings of Switzerland.

By Prof. EUGÈNE PITTARD, University of Geneva.

AS a result of the persistent drought at the beginning of 1921, the level of the Swiss lakes fell considerably, and hitherto-unsuspected depths were brought to light. This phenomenon was particularly marked in the three lakes of Neuchâtel, Bienne, and Morat, in which important areas had already been laid bare by the regulation of the waters of the Jura. Long stretches of beach which, until that time, had not been accessible to the inhabitants of the shore, completely modified the aspect of these lakes.

During the early months of 1921, in those districts in which the men of the polished stone age had built their dwellings, a large number of piles gradually emerged which the present generation had seen only under several feet of water. It was a revocation of vanished ages which appealed to the emotions. It enabled the imagination to reconstruct more readily a picture of those who, thousands of years ago, were the authors of the greatest of social changes when they introduced the cultivation of cereals, the domestication of animals, and the like. From day to day more and more of the substructure of these cities of the lake was uncovered, and from all parts travellers came to look upon this impressive spectacle, which perhaps we shall never see again.

It will be readily understood that such exceptional conditions encouraged Swiss men of science to undertake fresh investigations on several of the lacustrine sites.

The numerous finds which have been made since 1854 in all the lakes which were at one time inhabited by men of the stone age and the bronze age have enabled us to reconstruct, in great part, the material culture of these ancient populations. We have obtained, to some extent, an insight into their mode of life; we can frame hypotheses as to their race; but there are still many problems which require elucidation. I will indicate here a few of these problems which relate to the neolithic period.

1. We do not yet know with certainty to which ethnological group to assign the builders of the lake dwellings and their successors up to the end of the bronze age. It has been held, on the evidence of bones recovered from among the piles, that this type of habitation was invented or introduced by brachycephals—until that time unknown in Western Europe. Further, that this race held its own on the Swiss lakes until the end of the neolithic age, when dolichocephals begin to appear in the lake-dwelling sites, coming, perhaps, from the north. (Their ethnical affinities also are still to be determined. Will our hypotheses stand?)

FIG. 1.—Part of the site at Greng, Lake of Morat.

2. The dispositions of lake-dwelling sites, their town planning, if one may use the phrase, is, in essentials, unknown. Even the extent of the ground they covered in many cases has not been determined exactly.

What exactly was the topographical plan of each site? Were the sites, that is, those of the same epoch and situated on the same lake, arranged on a specific plan, identical throughout, or was a free rein given to the fancy of the builders in each case? In other words, was there a type of lake village, and, if so, what was it? Was the lacustrine city an organic whole, with the houses grouped on one frontage, or was it composed of a series of small islands, and, in that case, what were the dimensions and dispositions

of these islands? Did they communicate with one another by bridges or by navigable canals? If so, what were the measurements and arrangement of these bridges or canals?

What was the form of the dwellings? Those authors who have attempted to reconstruct groups of lake dwellings have differed remarkably in their attempts. These diversities show how little solid basis there is for our knowledge in this matter, notwithstanding the evidence from sites such as Schüssenried, Robenhausen, Niederwil, etc. Was the settlement protected against the waves caused by prevailing winds by some projecting construction—it may be assumed, a stockade of piles?

3. Do the most important of the articles in daily use by the inhabitants of the lake dwellings in the neolithic period date from the beginning of lake settlements? Were the various types of objects which are exhibited in the cases of our museums invented at different ages in accordance with the growth of needs, or were they in use in the earliest period? This question can be settled finally only by stratigraphical study.

4. Were the five domesticated animals of the neolithic period (the ox, the dog, the pig, the goat, and the sheep) present in the earliest period of the lake dwellings, or may we accept the suggestions put forward by various authors that these domestic animals were introduced gradually during the age of polished stone?

These are a few of the questions which still await an answer, notwithstanding the numerous investigations which have been undertaken since the memorable winter of 1853–54. The solution of these problems is naturally very difficult owing to the nature of the ground upon which investigations have to be carried out. It is not easy to make stratigraphical observations on sites which are always submerged. The diving bell alone can be used. It is for this reason that the persistent drought at the beginning of the year 1921 has proved so favourable to research.

Let us now consider the results which were obtained in the course of recent investigation.

Very few human skeletal remains of neolithic age were found; but an important discovery was made at St. Aubin. In the lowest stratum of this site, which is the oldest of the Swiss neolithic lake-dwellings, M. Vouga found a human cranium, which was sent to me. It is unquestionably dolichocephalic. This is the first piece of definite evidence of this character. Does it affect previous hypotheses as to the race of the builders of the lake-dwellings? I do not think on such slender evidence we can maintain that it does.

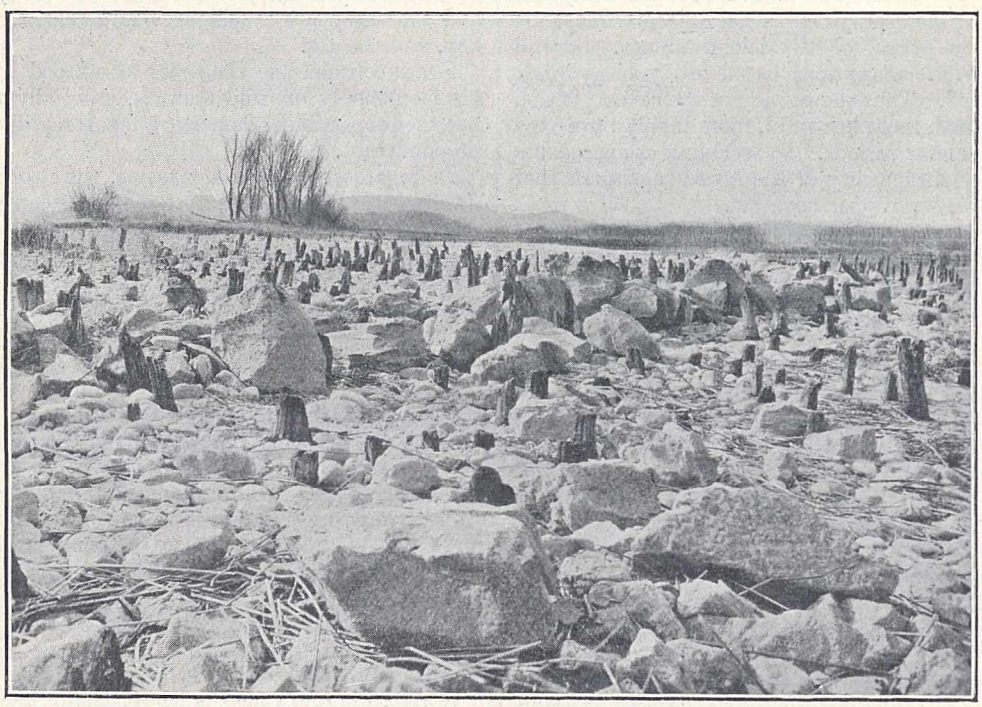

FIG. 2.—Part of the Neolithic site at Greng, Lake of Morat.

The skull in question is feminine, from which fact we may conclude that it belonged to an inhabitant of the site at St. Aubin and not to a foreigner, whose head might perhaps have been brought home as a trophy of war. The discovery, however, is of importance, because it was made in the course of investigations on stratigraphical lines. It is not a skull unearthed at hazard from the mud or sand. It was *in situ*.

In the course of the spring and the summer of 1921, two detailed topographical surveys were made—one, at my suggestion, at Greng in the Lake of Morat (Figs. 1 and 2) by MM. Le Royer and Winkler, the other on the foreshore of Geneva. This is the first time that any work of this character has been undertaken in Switzerland. The station at Greng was not completely surveyed. A record was made of the position of those piles only which were left uncovered by the fall of the lake and of those which were in shallow water. At Geneva, work of considerable extent was undertaken

by MM. Le Royer and Blondel. It has recently been completed (April 1922). Among the conclusions which emerge, it is now clear that the inhabitants of the lake-dwellings in the polished stone age had constructed stockades facing the open water, for protection against the waves raised by the prevailing northerly wind. These breakwaters must have afforded the dwellings relatively smooth water. From these investigations it may also be concluded that the lake-dwelling sites of Geneva were of considerable size. Unfortunately of these there remain to-day only some thousands of piles implanted in the bed of the lake.

Geneva is thus one of the most ancient cities of the world, since man has lived on this site continuously ever since the neolithic period.

The stratigraphical investigations undertaken by M. Vouga enable us to establish with certainty the succession of the types of industrial objects throughout the neolithic period of the lake-dwellings. Several of our *a priori* conceptions based on typology must be abandoned. Thus the pottery of the earliest period is more refined, more beautiful, more highly burnished than that of later periods. In technique it approaches more nearly the pottery of the bronze age than that of the middle and upper neolithic.

Thanks to a careful study of the stratification of objects found at Auvernier, M. Vouga has been able to plot out the progressive modification of several objects in daily use, such as the axe-hafting sockets of stag horn, flint arrow-heads, and the like.[1]

In many cases, however, stratigraphical study has only slightly modified classifications, such as those of Ischer, based upon the typology of lake-dwelling sites which have been investigated with minute care.

Other observations of importance for the history of culture have also been made by M. Vouga :—

The lowest stratum (IV.) has not yet yielded any of the spindle whorls which are necessary for weaving. The art of drilling stone would appear to begin in Stratum III., but only in the triangular axe hammer-head. The true perforated axe hammer-head appears much later—in Stratum I.

In Stratum I.—the latest—appear flint flakes of Grand-Pressigny type. Relations between Switzerland and western France are thus clearly established.

For the first time *all* bones found in the excavation of a lake-dwelling site have been preserved. My assistant, Dr. Reverdin, and myself have examined more than 4000 mammalian bones from the station of St. Aubin. Our conclusions, which are valid only in respect of the material obtained and for this site, may be summarised as follows :—In the neolithic period corresponding with the earliest lacustrine sites, the horse was not domesticated. It was not even hunted, or, if it was an object of the chase, its flesh was not brought back to the lake-dwelling. If this were the case, would it not be permissible to suggest a taboo as the reason ? The five domesticated animals of the neolithic period were represented in the lake-dwellings from the earliest times. Accordingly, the suggestion that domestic animals appear at different stages cannot be accepted. It is true that these five animals are not represented in equal abundance. At the beginning of the period of domestication, the goat and the sheep are much more rare than the ox, the dog, and the pig.

For a considerable time man continued to rely for his food-supply on wild animals, especially the stag ; but the proportion of domestic animals rapidly becomes preponderant.

As regards their culinary tastes, the neolithic lake-dwellers seem to show a preference for certain of the domestic animals. The species of which they ate most abundantly were the ox and the pig ; next come the dog (though it is not certain that the dog was eaten), the sheep, and the goat. What is the reason for this order of preference ? Does it depend upon a special taste for any particular meat ? Would they not in that case rear in large numbers only those species which they appreciated most ?

The lake-dwellers in the stone age ate the domestic animals when they were full grown, except in the case of the pig. This animal was frequently eaten while it was young, and even when it was still a sucking pig. The ox and the goat were never eaten when quite young. The distinction was dictated, without doubt, by the desire to use the milk-giving qualities of the cow and the goat, and also, perhaps, the sheep, as long as possible, but this explanation does not affect the males of these species.

It thus appears that the exceptionally low water in the Swiss lakes in 1921 has not been without interest to science. Thanks to this phenomenon, some new and important facts have been recorded in the history of the culture of the neolithic lake-dwellers and, at the same time, of all the neolithic peoples.

[1] I would refer the reader to the reports published by M. Vouga in "Indications d'Antiquités suisses" in the *Arch. suisses d'Anthrop. Gén.*, Geneva, 1921 and 1922.

Vitamin Problems.[1]

By Prof. A. HARDEN, F.R.S.

THE existence of three vitamins, termed A, B, and C, has now been firmly established and a general idea has been obtained of their distribution among animal and vegetable organisms. Hitherto, comparatively little quantitative work has been done in this direction, and further progress must depend on a more general adoption of quantitative methods. These are at present tedious and not very accurate. In the case of each of the vitamins the requirements of the special animal employed serve as the unit of comparison and these vary considerably from individual to individual, so that many observations are necessary if any, even moderate, degree of accuracy is to be attained. Thus in the estimation of the antiscorbutic potency of food materials, by the method worked out by Miss Chick and her colleagues at the Lister Institute, it has seldom been possible to achieve a greater accuracy than about 25-50 per cent. This obviously imposes a very serious limitation on any attempts to study variations in potency unless these are of a very gross order. Another great difficulty inherent in this kind of observation is that when the

[1] Abridged from a Discourse delivered at the Royal Institution on Friday, April 28.

potency is low, the necessary dose of the material to be tested is correspondingly high, and soon transcends what is permissible without interference with other necessary conditions of the diet, such as protein content, etc. Very much the same conditions hold with regard to Vitamin B, especially when this is estimated by the effect of the material on the growth of rats; and, as a matter of fact, the great bulk of the work carried out in America by this method is not strictly quantitative, but simply leads to the result that a certain ration does, or does not, suffice for the growth of a young rat.

As regards Vitamin A the method of Zilva and Miura promises to yield moderately accurate and consistent results. This is attained by keeping the experimental animals (young rats) on a diet totally deficient in Vitamin A until they have ceased to grow, and then ascertaining the minimum dose of the material to be tested which will induce definite and steady growth for four weeks. Animals which do not cease to grow in three weeks are rejected, greater uniformity in the results being thus attained. The test material is, whenever possible, administered quantitatively to the animal and not, as was formerly the practice, mixed with the ration in a known proportion. One of the immediate results of the application of this method has been the discovery that cod-liver oil, formerly classed with butter as a good source of Vitamin A, is in reality 200-250 times as potent as butter and is, along with similar fish-liver oils, by far the richest in this material of all the substances which have so far been examined.

A further piece of information, which is essential for the detailed study of these substances, is their behaviour towards heat, oxidation, etc. In this respect some progress has been made, and it may be stated with some confidence that both Vitamins A and C are moderately stable towards rise of temperature, provided that air be excluded, whereas in the presence of air they are rapidly inactivated. Whether the effect of air is reversible or not has not yet been ascertained. Vitamin B, on the other hand, appears not to be affected by air and is also moderately stable towards rise of temperature. None of the three vitamins is easily inactivated by hydrolysis under anaerobic conditions, and this fact has led to the interesting observation that Vitamin A, although usually associated, in the animal organism, with fat, is not itself a fat but remains in the unsaponifiable residue with almost unabated potency. This indicates how small a weight of the vitamin itself is necessary for the daily ration of a young rat. In some cases as little as 1·2 milligram of the oil is sufficient to permit of definite growth, and of this only 1-2 per cent. is unsaponifiable, while, as is well known, the chief constituent of the unsaponifiable matter is cholesterol, which has itself no vitaminic potency. The actual requirement of the vitamin itself must therefore be of the order of 1/500 milligram per diem. The other two vitamins have not been obtained in so concentrated a form, but it appears highly probable that they too are present in foodstuffs only in infinitesimal amounts.

The origin of all three vitamins is to be sought in the vegetable kingdom. The production of Vitamin A has been followed (Coward and Drummond) from the seed, and it has been found that it does not appear until the photosynthetic processes begin. Thus sunflower seeds are almost devoid of it, and so are the etiolated seedlings formed when these seeds germinate in the dark. In the light, on the other hand, the green seedlings, grown in a medium free from the vitamin, produce it freely. This vitamin is often closely associated with the carotene and xanthophyll of plants; so intimately, indeed, that it was at one time thought that it might be closely related to, if not identical with, one of them. The association, however, although very frequent, is not essential, and no definite relation can be shown to exist between the two. Vitamin C is either absent from seeds or only present in them in very minute amount, but appears when the seed germinates and before any green parts are formed. Nothing is, however, known of the inactive pro-vitamin or of the process by which it is rendered active.

Concerning the origin of Vitamin B a considerable amount of discussion has taken place. Its presence in a large proportion in yeast points to the probability that it can be produced without the intervention of light, and both in America and in this country it has been found that yeast can actually produce the vitamin when grown in a "synthetic medium" comprising only substances of known composition and free from the vitamin in question. Recently, however, Eijkman, in Holland, has obtained a contrary result, so that this question remains at the moment open.

The animal organism appears to be unable, in normal circumstances, to produce any of these principles for itself, and hence the amounts found in animal products depend ultimately on the diet of the animal. This opens up, among many other problems, the important question of the vitaminic properties of milk, and there seems to be no doubt, from experimental work, both here and in America, that these properties are profoundly affected by the diet of the cow. Milk obtained in winter when the animals are stall-fed has been shown to be markedly deficient in Vitamin A, and there is also great danger of a deficiency of Vitamin C. One of the pressing requirements of the moment is the careful quantitative examination of foodstuffs available for the feeding of cattle, so that a rational system of winter feeding can be adopted which will produce milk as good as that given in summer. Such an examination would seem naturally to fall within the purview of the Board of Agriculture.

The evil results of a deficiency of Vitamins B and C, especially in the diet of children, are well known—beri-beri and scurvy, latent or patent—but the effect of a lack of Vitamin A is not so well recognised or so universally acknowledged. One school considers that a deficiency of this vitamin is at least a prominent factor in the causation, if not, as they formerly held, the sole cause of rickets. Others consider rickets to be a disease brought on by non-hygienic surroundings, lack of fresh air and exercise, etc. The latest experimental results show that rickets (in rats) can infallibly be produced by dietetic changes, but that the lack of Vitamin A does not of itself lead to the disease unless at the same time the diet is faulty as regards the supply of calcium or phosphorus. This faulty mineral supply

does not usually lead to true rickets if sufficient Vitamin A be present, although the bone formation under these circumstances is not quite normal. This explains the well-known curative effect of cod-liver oil in rickets. So marked is the effect of this remedy, that McCollum, not appreciating the relatively enormous concentration of Vitamin A present in it compared with that in butter, as proved by Zilva, has suggested that cod-liver oil contains some other specific substance absent from butter, to which its great superiority is due. The difference, however, seems to be merely quantitative, and the further complication suggested by McCollum appears to be unnecessary.

These experiments on rickets have led to what promises to be a discovery of far-reaching importance. Rats on a diet, which in the laboratory will infallibly produce rickets, do not acquire the disease if they are exposed to sunlight in the open air or to ultra-violet radiation, and rats which have acquired the disease can be cured by either of these treatments, just as they can be cured by the administration of cod-liver oil. Sunlight and ultra-violet radiation have also been found to be effective cures or preventives of rickets in children. The cures by light and by cod-liver oil seem to proceed in precisely the same way, and the idea naturally suggests itself, especially to the mind of a chemist, that the light actually brings about the synthesis of the Vitamin in the animal body just as it does in the plant. This idea still awaits experimental verification or disproof; but there is no doubt that the discovery of this function of light will lead to profoundly important developments in our knowledge.

Obituary.

PROF. W. GOWLAND, F.R.S.

PROF. WILLIAM GOWLAND died on June 10 in his eightieth year. He had originally intended to enter the medical profession and actually worked with a medical man in Sheffield for two or three years. Afterwards he became a student at the Royal College of Chemistry, from which he passed in 1868 to the Royal School of Mines. Two years later he obtained the associateship both in mining and metallurgy. He was awarded the Murchison medal in geology and the De la Beche medal in mining.

His first post was that of chemist and metallurgist to the Broughton Copper Company, Manchester. Two years later he went out to the Imperial Mint at Osaka, Japan, and held the post of chemist and metallurgist there for six years. During the next eleven years he acted as assayer, metallurgist, and chief of the foreign staff at Osaka, and was for some time adviser to the Imperial Arsenal. His work was of a decidedly varied nature, and he did much to introduce Western metallurgical and chemical methods into the departments with which he was associated. It was during this period that he acquired the knowledge of Japanese methods of extracting, refining, and working metals for which he afterwards became so famous. He carried out exploration work in Korea on behalf of the Japanese Government, in the course of which his expedition had some lively skirmishes with the natives.

As a young man Prof. Gowland was a keen oarsman, and was the first to introduce rowing into Japan. He had two modern "eights" built to encourage boat-racing among the staff of the mint, but they found these craft too unstable for their liking. Eventually they decided to choose their own boats and presented two for his inspection: He found they had selected a pair of "cutters" and had fitted each with port and starboard lights. He was also the first to initiate the Japanese into the use of the wheelbarrow. He had occasion to do this in connexion with some excavation work in the copper mint, and provided the labourers with barrows. The next morning he was astonished to find that the wheels had been removed and the sturdy Japanese were carrying the loaded wheelbarrows. On leaving Japan in 1889, the order of "Chevalier of the Imperial Order of the Rising Sun" was conferred on him personally by H.I.M. the Emperor of Japan. During his residence there he gradually built up a very fine Japanese art collection, which included some valuable kakemonas.

Returning to England, Prof. Gowland acted as chief metallurgist to the Broughton Copper Company for some years, and in 1902 was appointed professor of metallurgy at the Royal School of Mines, in succession to the late Sir William Roberts-Austen. This post he held for seven years and retired in 1909.

So far as metallurgy is concerned, his chief interest lay in the non-ferrous metals, principally copper, silver, gold, lead, and their alloys. His knowledge, in particular, of the metallurgy of copper was unique, based as it was upon experience of the best methods in vogue, both in the East and West. In 1914 he published a textbook on the metallurgy of the non-ferrous metals which quickly became recognised as an authoritative work on the subject, and is now in its third edition. He also contributed various papers to the Institution of Mining and Metallurgy, the Chemical Society, and the Society of Chemical Industry. He was an original member of the Institute of Metals, its third president, and its first May lecturer. In 1907 he was elected president of the Institution of Mining and Metallurgy, and in 1909 was awarded the institution's gold medal.

There was, however, another side to his intellectual interests, as shown by his membership of the Society of Antiquaries, the Royal Anthropological Institute, and the Numismatic Society. His publications under these heads were numerous and varied, dealing with, *e.g.*, the early metallurgy of silver and lead, the remains of a Roman silver refinery at Silchester, the burial mounds and dolmens of the early Emperors of Japan, and silver in pre-historic and proto-historic times. From 1905 to 1907 he acted as president of the Royal Anthropological Institute.

Prof. Gowland was a man of great personal charm and distinction. He was extremely thorough in all he undertook, and never spared himself in the execution of his duty. His lectures were very carefully prepared and well delivered. The geniality of his disposition made him a general favourite with his colleagues and students, and he will always be affectionately remembered at the Royal School of Mines. H. C. H. C.

E. W. L. HOLT.

IT is with deep regret that we record the death in London on June 10, at the age of fifty-seven, of Mr. Ernest William Lyons Holt, Chief Inspector of Irish Fisheries. Educated at Eton, where he won the Biological Prize, he entered the Army through Sandhurst and joined the Duke of Cornwall's Light Infantry, with whom he served in the Nile Campaign of 1884–5 and afterwards in the Burmah War 1886–7, during which his health broke down and he was invalided home.

Retiring from the Army, Holt took up the study of natural history, in which he had always been interested. His first zoological research was carried out at the St. Andrews Marine Laboratory, and resulted in a paper on the morphology of the brain of fishes, especially of the herring, which was communicated in 1890 to the Royal Society of London. In the same year he was appointed assistant-naturalist for the survey of fishing grounds on the west coast of Ireland, which was being carried out by the Royal Dublin Society. As the result of cruises carried out in 1890 and 1891 a valuable series of papers was published, the most important of which dealt with the eggs and larvæ of fishes, while in others the economic aspects of scientific fishery investigation were ably dealt with.

In 1892 Mr. Holt was appointed by the Marine Biological Association to take charge of a laboratory which was opened near Grimsby for the purpose of studying the fishery problems of the North Sea. Here for three years he successfully carried out investigations dealing with all aspects of fish life in their relation to commercial fisheries, paying special attention to the destruction of immature fish by trawling, a question which was thought at that time to be of the greatest practical importance. On leaving Grimsby, he spent some time in the south of France, where he resumed his studies on eggs and larval stages, publishing a finely illustrated memoir on this aspect of the natural history of Mediterranean fishes. Following this, three years were spent at the Plymouth Marine Laboratory, where he not only continued and extended his work on fishes, but took up the study of several groups of invertebrates which are largely used as food by fishes.

In 1900 Mr. Holt returned to Ireland, where he became scientific adviser to the fisheries branch of the Department of Agriculture and Technical Instruction, succeeding the Rev. W. Spotswood Green as chief inspector of fisheries in 1914. Under his direction an important survey of the fishing grounds, especially to the west and south-west of Ireland, was organised and carried on for a number of years, the deep water of the Atlantic slope receiving a large share of attention. Mr. Holt gathered around him a brilliant staff of young naturalists, and an excellent series of reports was published. He continued to devote himself personally to the study of fishes, and included fresh-water fishes, especially the salmon, in his studies. His personal knowledge of fish life in all its aspects was probably greater than that of any other British naturalist, and at the same time he was a keen student of the literature of the subject. In his earlier years he had great facility as a draughtsman, and his papers were beautifully illustrated with his own drawings. He possessed an acute and critical intellect, a sound sense of proportion, and a quick eye for the things that really mattered in connexion with any question he took up. His work was greatly helped by a gift of rapid literary expression, accompanied by a quiet humour, which always made his writings interesting. His mind was essentially honest, he suffered from no illusions, and did his best to destroy what he thought were illusions in others.

E. J. A.

WE much regret to announce the death, on June 26, at the age of seventy-three years, of Albert, Prince of Monaco, well known for his oceanographical research work.

WE regret to see the announcement of the death, on June 22, of Sir Alexander M'Robert, at the age of sixty-eight years. After acting for a time as a lecturer in experimental physics and in chemistry, in Aberdeen, Sir Alexander went to India, where he passed the greater part of his life, closely associated with technical education. He was made a fellow of the University of Allahabad in the Faculty of Science, served on the committee of management of the Government Engineering College, Roorkee, and also as governor of the Agricultural College, Cawnpore. Sir Alexander had travelled extensively in many parts of the world, and received knighthood for his services in 1910, being created K.B.E. in 1919.

Current Topics and Events.

THE Council of the Zoological Society of London has approved a scheme for the establishment of an aquarium at the Zoological Gardens in Regent's Park. The aquarium is to be built under the Mappin Terraces, but so installed as to be invisible from the front, and will not interfere with the panorama of the Terraces. It will consist of a crescentic gallery, 400 ft. long, lined with tanks on both sides. Those on the outer curve will have both daylight and electric illumination, while those on the inner curve will be lighted by electricity only, a method used at the Berlin Aquarium with complete success. The gallery will be divided into three parts—fresh water, marine, and tropical aquaria—with special ponds for seals, diving birds, and trout. The tanks are to be constructed with the bottoms, sides, and backs of slate, and the fronts of polished plate glass set in a framework of white marble. They will be provided with rock-work arranged to suit the needs of their inhabitants. The water will be kept constantly circulating, flowing into the tanks from high-level reservoirs and thence through a series of underground filter-beds, on the plan of those in use at the New York Aquarium, to low-level reservoirs, from which it will be pumped by electric pumps to the high-level reservoirs again. Special arrangements are to be installed for heating

the tanks and for regulating the temperature of the water in the different aquaria. The plans for the gallery have been prepared by Messrs. Belcher and Joass, and the circulation, electric plant, and the heating, lighting, and ventilating systems have been designed by Sir Alexander Gibb. The scheme will cost about 50,000*l.*, and should provide London with the best-equipped and most carefully arranged aquarium in Europe.

A THIRD attempt to reach the summit of Mount Everest began on June 3. The monsoon being due to arrive early in June, it was clear that this must be the last attempt this season. The *Times* gives an account by Capt. Finch of his ascent with Capt. Bruce to 27,300 ft. in the previous attempt. The oxygen apparatus did not prove satisfactory and only one in ten was fit for use, but by reassembling the sound parts four serviceable sets were obtained. By the help of oxygen the climbers reached the North Col perfectly fresh and camped at 25,500 ft. A heavy gale with snow set in and lasted for two days, making progress impossible. When a start was made the Gurkha with the party collapsed and had to be sent back. Eventually, after five hours' diagonal climbing, Messrs. Finch and Bruce reached an altitude of 27,300 ft. The wind and cold were then so severe that they were compelled to turn, and reached No. 3 Camp thoroughly exhausted. A telegram from Jangkok, Sikkim, dated June 22, states that Dr. Longstaff, Major Morshead, Colonel Strutt, and Captain Finch have arrived there on their return from Tibet.

THE growing interest in metallography is well illustrated by the establishment of the Metallografiska Institutet of Stockholm, the formal opening of which has recently taken place. The new Institute is under the direction of Dr. Carl Benedicks, whose work on the physical chemistry of metals is well known. An inaugural address was delivered by Prof. Arrhenius, who referred to the international character of scientific research, as shown by the presence of foreign representatives at the ceremony, and by the review of the history of metallography contained in the address of Dr. Benedicks. Beginning with the work of Sorby in Sheffield, and continued by many workers, among whom the French worker, Osmond, was prominent, metallographic research has always preserved an international character. It was announced that Sir Robert Hadfield, who has himself made many important contributions to this branch of study, had presented to the Institute an annual sum of 150*l.* for two years, to form a scholarship for a research worker, Englishmen having a preference. In his statement regarding this foundation, Sir Robert Hadfield directs attention to the remarkable contributions made by Sweden to chemistry, and especially to the chemistry of metals. The metals used in the manufacture of alloy steels, such as nickel, cobalt, tungsten, molybdenum, and vanadium, were discovered by Swedish chemists, while direct contributions to metallurgy have been made by many of their compatriots, from Swedenborg and Bergman to Akerman and Brinell. The recent important work of Dr. Westgren on the space lattice of the allotropic modifications of iron, as determined by means of X-rays (NATURE, June 24, p. 817), is an addition to the record of which Sweden may be proud. It must not be forgotten, also, that the Sheffield steel industry owes its existence to the use of the pure Swedish irons obtained from native ores.

THE *Quest* arrived at Cape Town on June 18 from South Georgia *via* Tristan da Cunha and Gough Island. The *Times* announces that, in view of the low power and small size of the ship, it has been decided to abandon the proposed cruise in search of lost islands in the Southern Ocean and to return home. Landings were made at Tristan da Cunha, Inaccessible, Nightingale, and Gough Islands. At the last of these islands several days seem to have been spent ashore, during which some biological collections were made. The visit of the *Scotia* in 1904 showed that Gough Island has a most interesting fauna and flora, particularly worthy of study because the nearest land, with the exception of the Tristan da Cunha group, is South Africa, which is some 1500 miles distant. Details of the *Quest's* deep-sea soundings are not given, but they should be of great interest, since between South Georgia and Tristan da Cunha she traversed an area of the ocean in which practically no soundings have previously been taken.

NEWS from Mr. Knud Rasmussen, published in the *Times*, gives some account of his work in Melville Peninsula and Fox Basin until the middle of last January. The autumn was spent around Lyon Inlet, which offered scope not only for biological work, but also for researches into Eskimo archæology. During the winter, Mr. P. Freuchen was engaged in charting the western coast of Baffin Land against Fox Basin, which was imperfectly known. Mr. Rasmussen himself went south to Chesterfield Inlet near the mouth of Baffin Bay. To the west of this inlet two tribes of inland Eskimo are reported to live. This is of interest because all other tribes of Eskimo are coast dwellers. This autumn Messrs. Rasmussen and Freuchen hope to start on their long journey to the west across the Barren Lands through the area inhabited by the Kinipetu tribe, in an attempt to investigate the original routes of migration of the Eskimo, and to throw light on their origin.

DR. CHARLES D. WALCOTT, secretary of the Smithsonian Institution, has left Washington to continue his geological explorations in the Canadian Rocky Mountains. Dr. Walcott's work in previous seasons has done much towards clearing up the geological formations of this interesting region, and many thousands of fossil specimens have been brought back to add to the completeness of the exhibition and study series of the U.S. National Museum. One of the important results several years ago was the discovery of fossil bacteria in the pre-Cambrian rocks, probably the earliest form of life on the earth. The section to be studied this year will take in several localities north and south of the Bow Valley between

Banff and Lake Louise on the Canadian Pacific railroad. The particular problems to be attacked are connected with the growth of certain formations and the sequence of marine life in the rocks composing them. It is expected that many photographs of glaciers, mountains, and forests will be obtained.

AT the meeting of the Royal Society of Edinburgh on June 19, the Keith Prize (1919–1921) was presented to Prof. R. A. Sampson for his astronomical researches, including the papers "Studies in Clocks and Time Keeping: No. 1, Theory of the Maintenance of Motion; No. 2, Tables of the Circular Equation," published in the Proceedings of the Society within the period of the award; and the Neill Prize (1919–1921) was presented to Sir Edward Sharpey Schafer, for his recent contributions to our knowledge of physiology, and in recognition of his published work, extending over a period of fifty years.

WE have received an intimation that the Italian Royal Committee for Scientific Marine Investigations has assumed charge of the Zoological Station at Rovigno, Istria, which was formerly under German administration, and that the station is now in active work, with Prof. Raffaele Issel as Director.

THE second lecture of the series on physics in industry, arranged by the Institute of Physics, will be given on Tuesday, July 4, at 5.30 p.m., in the hall of the Institution of Electrical Engineers, Victoria Embankment, W.C.2, by Sir J. Alfred Ewing, whose subject will be "The Physicist in Engineering Practice, with Special Reference to Applications of Thermodynamics." The chair will be taken by Sir Charles A. Parsons, vice-president of the Institute.

THE fifth international Neo-Malthusian and Birth Control conference will be held in London on July 11-14, under the presidency of Dr. C. V. Drysdale. Many delegates from abroad are expected and the discussions have been arranged to take place in several sections. A visit to Dorking is arranged for July 15. This was the birthplace of the Rev. T. R. Malthus, author of the famous essay on the Principle of Population.

The American Geologist, which in 1905 was merged with *Economic Geology*, now resumes independence as *The Pan-American Geologist*. This monthly journal, devoted to speculative geology, constructive geological criticism, and geological record, is edited by Dr. Charles Keyes, Des Moines, Iowa. The associated editors are Edward W. Berry, Baltimore, Md.; Eliot Blackwelder, Cambridge, Mass.; Henry S. Washington, Washington, D.C.; and Gilbert D. Harris, Ithaca, N.Y. The first issue, volume xxxvii. No. 1, appeared in February last.

RECTANGULAR glass jars suitable for the exhibition of museum specimens were, before the war, generally obtained from Germany. Recently some attempt has been made to draw again on that source, but the difficulties remain considerable. For many years the Museums Association has sought to rouse British manufacturers to the desirability of meeting the ever increasing need, but it is only now that any satisfactory result has been attained. We understand that there are at least two firms willing and able to meet the demand. The June number of the *Museums Journal* publishes a list of the sizes that can readily be made and asks curators to state their needs without delay. We regret to learn that Dr. Tattersall, the secretary of the Association, to whom this development is due, is at present ill, but letters may be addressed to the Secretary of the Museums Association, care of E. E. Lowe, The Museum, Leicester.

THE Journal of the Society of Glass Technology of May contains papers on the melting of glass, the action of analytical reagents on glass, methods used in determining the durability of glass, Zulkowski's theory of the relation between the composition and durability of glasses, and other subjects. It is clear from the contents of various issues of this journal which have been received that research on glass and matters relating thereto is proceeding in a very satisfactory manner, and the great improvements which must result from this scientific investigation may be expected to have a most beneficial effect on the British glass industry. It is satisfactory to note that the Journal is acquiring an international status, since one paper in the present issue comes from the Geophysical Laboratory of the Carnegie Institution of Washington, although many of the best papers owe their inception to the work of Prof. Turner, of the Department of Glass Technology of the University of Sheffield.

ON Wednesday June 7, a lecture was given by Prof. A. F. Holleman, of Amsterdam, at the Imperial College of Science and Technology, under the auspices of the University of London, entitled "Recent Researches on Substitution in the Benzene Nucleus." After a brief statement of the position of the subject at the time (1910) of the publication of his book, "Die direkt Einführung von Substituenten in den Benzolkern," Prof. Holleman dealt with the qualitative and quantitative investigations which have since been carried out in the laboratories at Amsterdam. Considering the matter in the light of his own and Boëseken's theory as to the mechanism of substitution (involving primary addition to one or other of the Kekulé double bonds), it was shown that in many complex instances the extent to which substituents enter the different positions can be predicted with fair accuracy from the general rules which have emerged from the experimental study of the simpler cases. Full emphasis was laid on the exceptions and unforeseen results. Indeed the whole discourse was highly critical and gave an illuminating insight into the methods by which, under Prof. Holleman's direction, the workers at Amsterdam are gradually reducing to ordered measure the whole chemistry of benzene substitution.

IN the editorial remarks in the opening pages of the Journal of the British Science Guild for May, attention is directed to a departure, namely, the inclusion of matter going beyond the actual records of the work of the Guild. No doubt the wider scope

thus afforded in emphasising the benefits of applied science will be appreciated by readers. Interesting light is shed on two incidents during the war—the Coronel sea-battle and the German advance in 1914—both illustrating the importance of accurate information regarding warfare on land and sea. Among other matters that are the subject of editorial comment may be mentioned "The Science of Sailing," "The Bases of Politics," and "The Need for a Scientific Missionary Journal." Much of the issue is naturally devoted to the annual report of the Guild and the annual meeting. Special interest attaches to the address of Sir Richard Gregory explaining the origin of the appeal to be conducted by Commdr. L. C. Bernacchi for funds to consolidate and extend the Guild's activities. Among other important steps may be mentioned the establishment of local branches of the Guild and the completion of the catalogue of scientific books, comprising over 6000 entries—in itself a remarkable piece of work that justifies the Guild's existence. A summary is given of Sir Leslie Mackenzie's address at the Edinburgh meeting of the British Association on "Science and Citizenship," and a tribute is paid to the memory of Sir Ernest Shackleton, whose passing away on the *Quest* at the commencement of this year will be fresh in the minds of readers, and whose achievements in the field of polar exploration will not soon be forgotten.

A NEW catalogue (No. 94) of second-hand works on Zoology, Botany, and Agriculture has been issued by Messrs. Dulau & Co., Ltd., 34 Margaret Street, W.1. Among the 1400 volumes listed are two of especial interest, namely, a nearly complete set of *Curtis's Botanical Magazine*, formerly the property of Sir Joseph Hooker, with MS. corrections in nomenclature by Sir W. J. and Sir J. D. Hooker, and an unusual French Herbal, entitled "Recueil des plantes les plus usuelles peintes d'après Nature," in 12 vols. containing nearly 5000 illustrations drawn and coloured by hand, with manuscript descriptions.

MESSRS. W. HEFFER & SONS, Ltd., Cambridge, have just issued a list (No. 213) of some 600 works in new condition which they offer at greatly reduced prices. Many of the books listed deal with scientific subjects. The catalogue is obtainable from the publishers upon request.

A REPORT of the address given by Mr. F. W. Sanderson to the National Union of Scientific Workers, just before his death, is to be published shortly. Copies may be obtained from Maj. A. G. Church, General Secretary, 25 Victoria Street, S.W.1.

THE firm of Mr. T. Fisher Unwin, Ltd., 1 Adelphi Terrace, London, W.C.2, is arranging for the publication of the memoirs of Sir William Crookes, edited by Dr. Fournier d'Albe. Any letters and information likely to be useful to the editor will be gratefully received and carefully preserved and returned.

Our Astronomical Column.

SKJELLERUP'S COMET, 1922 *b*.—This proves to be a short-period comet of the Jupiter comet-family. The following elliptical orbit has been derived from observations on May 20, 31, June 12, the third being by Dr. W. H. Steavenson at Norwood.

$T = 1922$, May 15, 0·0325 G.M.T.
$\omega = 354^\circ\ 47'\cdot20$
$\Omega = 215^\circ\ 43'\cdot31$ } 1922·0.
$i = 17^\circ\ 23\ 36$
$\phi = 43^\circ\ 9'\cdot00$
$\log a = 0\cdot44930$.
$\log q = 9\cdot94904$.
Period = 4·7201 years.

These elements indicate a much closer approach to the earth than the parabolic elements did. Prof. Leuschner has pointed out that the comet is probably identical with 1902 II., discovered by Mr. John Grigg in New Zealand, and followed by him for 11 days. No one else saw it, and the observations were too rough to give a good orbit. If the period of less than 5 years is confirmed it will be the second shortest cometary period known, that of Encke, 3·3 years, being the shortest.

SOLAR ATMOSPHERIC CHANGES.—In the current number of the Monthly Notices of the Royal Astronomical Society (April) there are three communications relative to solar activity. The first is by Dr. William J. S. Lockyer, and deals with the relationship between solar prominences and the corona. In 1903 Dr. Lockyer published a paper on the same subject, concluding that the various forms of the corona, as photographed during eclipses, were dependent on the positions and intensities of the zones of prominence activity. In the present paper, using quite independent prominence and corona data, the former extending over the period 1890–1920 and thus including three sunspot maxima and minima, he points out that the previous conclusion is well endorsed by these new observations. Mr. A. M. Newbegin publishes the results of his solar prominence observations for the year 1921 and gives curves showing mean areas and mean numbers. He shows that the main zones of prominences were situated in latitudes 40° N. and 55° S., and a much lesser zone of activity in latitudes 20° N. and 25° S. These zones are in conformity with the curves of latitudes of prominences illustrated in Dr. Lockyer's paper referred to above, the higher latitude zones being the commencement of a new zone of activity which will gradually move polewards.

Mr. C. P. Butler communicates a first paper on the systematic distribution of solar calcium flocculi, this contribution dealing with inclination of elongated groups. Several observers have previously shown that the mean inclinations of the axes of sunspot groups were found to vary from 0° to 11°, and that the amount of inclination increases with the solar latitude of the group. Mr. Butler has investigated the case of the areas of calcium flocculi as determined from measures taken from photographs secured with the spectroheliograph. He concludes that the inclinations range in general from 0° to 40°, with a few cases of specially high inclination. The range is therefore much greater than that found for spot-groups. In the above range there are maximum frequencies at certain latitudes, namely, 15°, 21°, and 28°-32°. Other more detailed results are given.

Research Items.

PROBLEMS OF RACE AND NATIONALITY IN SOUTH AFRICA.—The problems of race and nationality are discussed in the presidential address delivered before the South African Association for the Advancement of Science by the president, Dr. J. E. Duerden. He gives an instructive survey of the social condition of the Bantu races and of the European immigrants. The hereditary attributes of all the people of colour are markedly inferior to the white in all that pertains to the requirements of modern civilisation, and there is every reason to expect that they will remain so in the future, "for in considerations of this nature the teachings of zoology are overwhelmingly in favour of the unchangeableness of the germ plasm." He goes on to say that the Nordic race, represented by the English and Dutch, stands at the head of the human genus, and "it is in the daily competition with those that the Bantu, Indian, and Malay are to lead their lives. In the commingling of these races in South Africa there can be no question as to which will be dominant. In his hereditary endowments the white is far more gifted than the coloured, and must lead. Dominance, however, is not arrogance, nor does superiority necessarily carry with it harshness or unfairness."

SECRET SOCIETIES IN THE SOUTHERN SUDAN.—The spread of secret societies among the Sudanese is a question of some political importance, and the reports of several correspondents on the subject are summarised in *Sudan Notes and Records* (vol. iv. No. 4). The baneful influence of such associations has attracted the attention of the Government, which has recently revised "The Unlawful Societies' Ordinance" in order to bring them under control. The authorities emphasise their evil influence through terrorism, debauch, and robbery, and it is suggested that they are mainly the work of unscrupulous persons who exploit the fears of primitive man for their own nefarious ends. But, as is the case with similar organisations among tribes of the lower culture elsewhere, it is believed that the use of "fetish" or other magical objects in their rites implies a religious side to the practices of these societies which deserves to be more closely studied. It would be interesting to learn whether these cults are regarded as supplementary or antagonistic to the traditional beliefs and rites of the uninitiated members of the community, and whether their influence depends on the transitory prestige of some particular leader, or is deeply rooted in the official religion of the tribe.

GEOLOGY OF MESOPOTAMIA.—An interesting memoir just issued by the Geological Survey of India (Memoirs, vol. xlviii., 1922) embodies the results of Dr. E. H. Pascoe's reconnaissance of the part of Mesopotamia lying mainly to the east of the Tigris from about the latitude of Baghdad to that of the Great Zab river just below Mosul. Excluding the recent alluvium and the pleistocene conglomerates, the rock groups described are all of Tertiary age and fall naturally into two divisions:—(*a*) a lower, marine, gypsiferous series corresponding to a part of Dr. Pilgrim's Fars series of the Persian Gulf region; and (*b*) a younger fluviatile series, which is provisionally named the Kurd series and corresponds generally with the beds distinguished by Dr. Pilgrim as the Bakhtiyari series in Persia. The older, marine, gypsiferous beds were laid down in a relatively shallow gulf, which became silted up and finally gave place to fluviatile conditions after an intermediate stage of salt lagoons. Local erosion naturally occurred during this transition stage, but there is no general or widespread unconformity dividing the marine from the later freshwater formations by which the former were covered. Folding of the sediments commenced in Fars times and became accentuated during the subsequent Kurd period, persisting into recent times; this is indicated by the marked steepening of the dips noticeable in passing from the upper to the lower series, while there is in general a marked contrast between the compressed condition of the anticlines and the open disposition of the alternating synclinal folds, which Dr. Pascoe ascribes to the circumstance that the rising anticlinal saddles became eroded and consequently weakened, thus yielding more readily to compressional earth-movements. Petroleum is of outstanding importance among the minerals of economic value, and the conditions for its occurrence are so favourable that Dr. Pascoe regards Mesopotamia as a possible rival of Persia, outclassing Burma altogether in oil resources. Associated with the oil are small quantities of pitch and bitumen, while sulphuretted hydrogen is evolved in such large quantities that its recovery as a source of sulphur (or alternatively as sulphuric acid) is recommended as commercially feasible.

AMERICAN CRETACEOUS DINOSAURS.—The first of a series of preliminary notices on the Cretaceous dinosaurs, obtained in Alberta from 1910 to 1915 by parties sent out by the American Museum of Natural History under Mr. Barnum Brown, has been issued. The article in question, by W. D. Matthew and B. Brown (Bull. Amer. Mus. Nat. Hist., vol. xlvi.) treats of "The family Deinodontidæ." This family name was introduced by Cope in 1866, under what is now considered the more correct rendering for the Greek, as Dinodontidæ, but the authors of the present brochure have altered it, presumably because the type genus, when founded by Leidy in 1856, was rendered, as then customary, as Deinodon. But if Leidy's original is to be scrupulously adhered to, why not Cope's? The authors discuss the group and give a most valuable "Chronological list of American Cretaceous Deinodonts and Ornithomids." Appended is a description of *Dromæosaurus albertensis*, n. gen. et sp., from the Cretaceous of Alberta, and the conclusion is reached that it should be placed in a distinct subfamily, Dromæosaurinæ.

ENTELODONTS FROM THE OLIGOCENE OF SOUTH DAKOTA.—W. J. Sinclair describes the "Entelodonts from the Big Badlands of South Dakota in the Geological Museum of Princeton University" (Proc. Amer. Phil. Soc., vol. lx.), some of which had been previously inadequately determined, and had even figured in literature under other names. The new forms include two new species of Archæotherium and *Scaptohyus altidens*, n. gen. et sp. The origin of the group as a whole is uncertain. Apart from the digging proclivities of Scaptohyus, one of the most clearly indicated "habits" of the entelodonts, according to the author, judging from lesions in the preserved remains, appears to have been their pugnacity; but surely the argument is equally allowable that the injuries were due to attacks by powerful enemies.

PETROLEUM IN THE PHILIPPINES.—In the *Philippine Journal of Science* of January last, Dr. Warren D. Smith gives a detailed account of his geological reconnaissance of the Pidatan Oilfield, Cotabato Province, Mindanao, the second largest island of the Philippine group. The occurrence of petroleum in the Philippine Islands has been known for some years, surface indications existing in Luzon, Mindoro,

Panay, Cebu, and Leyte; those of the Cotabato district in Mindanao, in particular the Pidatan seepage, are of more recent discovery, Pidatan not receiving detailed geological attention until the expedition of 1921, of which this paper is a report. The Pidatan field is about 60 kilometres north of Fort Pikit, Cotabato Province, the basin of the Rio Grande de Cotabato, practically in the centre of the island. The topography is mountainous and the country is exceedingly difficult. Geologically, the formations present consist principally of Tertiary limestones, sandstones, and shales pierced by basaltic and andesitic intrusions. The sediments are of recent, Pleistocene, Pliocene, and Miocene ages, many horizons yielding fossil evidence. The structures, however, appear to be very complex, owing to the regional earth movements and the igneous activity manifested. In fact, the faulting and folding has so disturbed the oilfield region that Dr. Smith does not hesitate to condemn the area from the economic point of view. On the other hand, the presence of the seepage and the nature of the oil involved at Pidatan suggest that petroleum certainly occurs in central Mindanao, possibly over an extensive region, and the advisability of intensive geological exploration over a wider area is clearly indicated. Analysis of the oil from the occurrence at Pidatan shows that it has a specific gravity of 0·9297 and is of paraffin base; no light fraction was obtained (under 150° C.), kerosene and heavy oil representing 45 per cent. and 49·5 per cent. of the sample respectively (by volume). Results of other tests indicate that the oil is much inspissated, as would be expected considering the geological circumstances, and is most suitable for use as a Diesel engine fuel. The author concludes his paper with a commendable caution to those controlling oil companies against belittling the value of sound geological work as a necessary preliminary to oil exploration; while not detracting from the value of the "practical" man's work, he makes it quite clear that success is achieved only where both driller and geologist work in harmony, a conclusion deserving of serious consideration by many of the would-be "wild-cat" oil explorers in our own colonies.

THE GEOLOGY OF THE MOUNT EVEREST DISTRICT.—The Mount Everest expedition of last year included among its staff Dr. A. M. Heron, who contributes to the *Geographical Journal* of June an account of his geological investigations, accompanied by a geological map. The mapping is virtually a westward continuation of Sir H. Hayden's investigations during the Tibet Expedition of 1903–4. Dr. Heron's task was one of unusual difficulty. Over much of the area examined his work had to proceed in advance of surveys, while the movements of the expedition were generally unfavourable to detailed work. Close and prolonged examination, moreover, was considered inadvisable, since it aroused the suspicions of the Tibetans. Dr. Heron claims that his work must be looked on only as a reconnaissance. The area examined covers more than 8000 square miles, and consists in the main of the Tibetan portion of the drainage area of the Arun river above Kharta. Two geological divisions can be recognised: a Tibetan area of sedimentary rocks which consists chiefly of east and west folds of Jurassic slates, and the crystalline Himalayan region to the south. The contrasts in topography clearly illustrate the differences in the underlying structure. On one hand are the somewhat tame rounded ranges, with broad valleys, of Tibet, and on the other the high, steep, and rugged Himalayas.

RECOVERY OF SUGAR FROM BEET MOLASSES.—Beet molasses is a substance of almost constant composition, containing 50 per cent. of sugar, 10 per cent. of ash, 15 per cent. of other organic substances, and 25 per cent. of water. The sugar cannot be separated from it by direct means, and among the methods employed for recovering the sugar is precipitation by one of the alkali earths. Until the present lime and strontia have chiefly been used. In the year 1838, however, Peligot found that baryta forms a very sparingly soluble saccharate. The use of baryta for the purpose of separating sugar was never carried out to any great extent for two reasons; (*a*) its cost, and (*b*) the poisonous nature of barium compounds. The cost of baryta should now be considerably reduced by the discovery of two French chemists, MM. Camille Deguide and Paul Baud (*Comptes rendus*, May 1), who find that when barium carbonate is heated with silica at a temperature of 150°-200° C., and the mixture subsequently lixiviated with water, the carbonate is to the extent of more than 90 per cent. converted into hydroxide. This process should therefore render baryta available for the desaccharification of molasses. It is, however, very doubtful whether any Government will permit its use on account of the toxic character of traces of barium compounds.

PYREX GLASS.—The *Chemiker Zeitung* of May 25 contains an analysis of the "Pyrex glass" manufactured in America and used for cooking vessels. This glass is an astonishing resistant to changes of temperature, and may be used over an open fire. The chemical composition was found to be, in percentages: silica, 80·71; boric anhydride (B_2O_3), 10·47; alumina, 3·55; lime, 0·70; magnesia, 0·57; soda (Na_2O), 4·14. The low alkali content is noteworthy. Experiments showed that ordinary heating is not sufficient to melt the materials for such a glass, and special furnaces, possibly with surface-combustion heating, are assumed.

SAFETY DEVICES IN WIRELESS EQUIPMENT.—The American Bureau of Standards has given its approval to the recommendations of a committee of the National Fire Protection Association proposing the addition of some new safety rules to the National Electric Code relating to wireless telegraph installations. The proposed regulations provide for the protection of receiving and transmitting equipment against lightning effects, avoidance of risk of contact with neighbouring electric light and power circuits, and protection from effects of high potential surges in the lines supplying power to the equipment, as well as the ordinary requirements of sound construction. It is needless to detail all the proposals, but it may be remarked that, in the case of receiving equipments, a lightning arrester is required where the leading-in wire enters a building and, on account of the larger size of the ordinary transmitting aerial, which is more likely to be subject to damage from lightning, and the high voltages produced in the apparatus, the provision is recommended in transmitting stations of a double-throw switch for connecting the aerial either to the transmitting apparatus or to earth. The use of this switch makes it possible to disconnect the aerial entirely from the transmitting apparatus. On account also of the difficulty which has been experienced by the induction of voltages in the supply lines of a transmitting station, it is advisable to use a protective device across the power line near its point of entrance. It is noticeable that copper-clad steel wire is recommended throughout as an alternative to copper wire, owing to the fact that these two kinds of wire are practically equivalent in their conductivity for high-frequency current, while the former is stronger mechanically.

Quantum Mechanism in the Atom.

AT a meeting of the Royal Society of Edinburgh on May 8 Prof. E. T. Whittaker read a paper on the quantum mechanism in the atom (since published in Proc. Roy. Soc. Edin., vol. xlii. pp. 129-142).

Prof. Whittaker shows that it is possible to explain quantum phenomena satisfactorily in terms of the classical electrodynamics without postulating any structure in the atom beyond that by which it is customary to explain induced magnetisation. The author considers the effect of an approaching electron in producing a "magnetic current" in the atom; up to a certain velocity of approach the electron does not get beyond the atom but suffers an "elastic impact" which repels it without loss of energy. When, however, the velocity of approach exceeds this critical value the electron passes through the magnetic atom and gives to it energy of exactly that amount or quantum which corresponds with the critical velocity. The transformation of this energy into radiant energy can be explained by generalising the conception; thus the magnetic current becomes equivalent to a charged condenser, partaking of the nature of a Hertzian oscillator. By a simple mathematical process, combined with the assumption that the oscillators in the atoms are similar to each other in structure and differ only in scale, the equation $h\nu = U$ can be established, giving Planck's relation connecting the frequency, ν, of the emitted radiation with the amount of kinetic energy, U, absorbed from the bombarding electron. A more definite form to the quantum mechanism is given by linking a conducting circuit with the magnetic structure. Photo-electric phenomena can be interpreted on the basis of this theory, and Bohr's theory of series-spectra likewise finds an explanation.

Sir Alfred Ewing suggested that instead of following Prof. Whittaker in leaving the magnetic atomic model at a certain point there is perhaps an advantage in not dropping the model, especially as it seems to give an immediate explanation of the manner in which oscillations are set up as the electron parts with its quantum of energy. In the Ewing magnetic model the central magnetic system or wheel is controlled by an outer system or ring. When an electron passes through and escapes it gives an impulse producing relative angular displacement of inner wheel and outer ring, and the mutual magnetic forces tend to restore the original configuration. Oscillations are set up which expend their energy in emitted radiation. Conversely, in an atom in which oscillations are going on, an electron may be ejected (photo-electric effect). In being ejected it exerts an angular impulse which stops the oscillation and deprives the atom of the quantum of energy originally absorbed through resonance.

Dr. H. S. Allen directed attention to the fact that in Prof. Whittaker's "calamoids," or four-dimensional tubes of electromagnetic force, as well as in the Ewing magnetic model, magnetic forces rank on an equality with electrostatic forces. The number of magnetic tubes associated with Prof. Whittaker's magneton must be an integral number of times the unit quantum tube of magnetic induction. More satisfactory is a modified form of the quantum mechanism, in which two ring electrons are placed near together on the same axis, the electromagnetic force between them being repulsive. Such models cannot, in Dr. Allen's opinion, "reconcile" quantum dynamics with classical dynamics.

Dr. R. A. Houstoun suggested the advisability of testing Prof. Whittaker's theory by an appeal to numerical calculation, introducing, for example, definite values of the frequency and calculating the corresponding size of the molecule. The results appear to be satisfactory considering the simple nature of the assumptions made. It seems that the reciprocity which exists between electric and magnetic quantities in the electromagnetic wave must be extended to atomic structure.

Prof. Peddie remarked that the value of Prof. Whittaker's idea does not lie in its being an "only possible" one, for other possibilities exist. Its importance rests on the fact that the idea is a new one, giving for the first time an action on an electron which is not reversed in direction when the electron passes through an atom. A "perfectly elastic" collision seems to be attainable only by implicitly denying collisional radiation, which leaves part of the essential mechanism undescribed. The interactions of the atomic charges, ether and the "magnetic currents," may perhaps introduce difficulty regarding atomic subjection to the Newtonian first law of motion.

The Second Royal Society Conversazione.

THE second conversazione of the Royal Society this year was held in the rooms of the Society at Burlington House on the evening of June 20, when the president, Sir Charles Sherrington, with Lady Sherrington, and the officers of the Society, received a large number of fellows and guests. Many interesting scientific instruments and specimens were shown, several of which were exhibited at the first conversazione held on May 17, and some were briefly described in NATURE of May 27, p. 693. Below are brief descriptions of other noteworthy exhibits.

Some selections from the contents of large prehistoric cooking-places at Buckenham, Tofts Park, Norfolk, were shown by Miss Nina F. Layard. The specimens were found by Miss Layard and Miss M. F. Outram in 1921–1922, and they include hearth-stones, heating-stones, bones and teeth of animals, fragments of pottery, flint flakes and implements. Mrs. Clayton exhibited a Roman bronze measure of capacity, made under Domitian, which was found during draining works in the vicinity of the Roman Wall, three miles east of Gilsland, Northumberland.

A simple form of respiration meter was exhibited by Mr. H. F. Pierce. Two bellows are mounted on a vertical shaft, one of which measures the volume of inspired air, the other the volume of expired air. The latter is measured at a temperature of 37·2° C. to avoid error due to condensation of contained moisture. Respiration is recorded quantitatively upon a smoked drum. The moving parts are made very light and valves are operated electrically.

Mr. G. C. Robson had an exhibit showing that a highly differentiated character which appears discontinuously in the parthenogenetic gastropod, *Paludestrina jenkinsi*, does not reappear in two generations bred from parents showing this character. There is evidence that this character cannot be compared with an ordinary "fluctuating" variation. The Royal Botanic Gardens, Kew, showed a double coconut, or Coco de Mer, from the Seychelles, which

was germinating. The massive cotyledonary tube emerges from the nut, carrying the plumule and radicle out of the seed, and later the plumule pushes through the tube and grows up into the air. Specimens of the tubers of Ecanda rubber (*Raphionacme utilis*, Brown and Stapf) from Angola, which sometimes weigh as much as 15 lbs., and contain valuable rubber, were also shown.

Mr. W. Barlow exhibited some models of organic substances which are based on the law of valency-volumes and are in harmony with the Bragg structure found in the diamond. The valency-volume unit-cell appropriate for the carbon compounds is a rhombic-dodecahedron. The fundamental valency of carbon is expressed by a close tetrahedral group formed of four of the cells—that of nitrogen by three cells triangularly arranged, that of oxygen by two cells in face-contact, and that of hydrogen by a single cell. By fitting together appropriate numbers of these cells representing the composition and constitution of various compounds, structures can be made representing molecules which present internal symmetry closely corresponding with that of the crystal forms of these organic substances.

The Research Department, Woolwich, had an exhibit showing the time reaction in the colour change of Congo red in organic solvents. The change from red to blue which occurs during titration is associated with its flocculation from the colloidal condition and forms a time reaction related to the concentration of H ions and other properties of the solvent. There were also exhibits from the Air Ministry (Instrument Section), among which was a radiator temperature outfit designed to determine the temperature distribution at different points on an aero-engine radiator and its connecting pipes. A six-junction thermocouple is used, and each set of junctions measures the temperature relative to that of the atmosphere. Another exhibit was a Filon aneroid dial for indicating to the pilot the height of an aeroplane above the ground. The scale is coiled into a spiral groove so that it can be adjusted to meet daily changes in temperature and barometric pressure. A metallic oxygen container was also shown in which a small quantity of silica-gel has been used successfully for cleaning up residual gases.

Mr. A. A. Campbell Swinton demonstrated the recording of wireless telegraphic messages. A short aerial on the roof of the building was connected through a tuner to a thermionic three valve amplifier, which in turn was connected to a 1 to 3 valve note magnifier. A moving coil siphon recorder was used, connected to the note-magnifier, either through a Brown relay, or through a very low frequency thermionic amplifier tuned to respond to the frequency of Morse signals. For the reception of continuous wave signals a separate thermionic heterodyne oscillator is employed which renders the high frequency signals audible by means of musical "beats." Dr. H. E. Hurst and Mr. D. A. Watt exhibited an interesting model, on a scale of 1 : 50, of the sluice of Aswan dam which is used for calibration purposes. The relation between Q, the discharge of the actual sluice, and q the discharge of the model is given very closely by $Q/q = n \cdot 5/2$, where n is the scale ratio.

Psychical Monism.

THE Journal of the Washington Academy of Sciences of March 19 contains a communication from Mr. L. T. Troland of Harvard University entitled "Psychophysics as the Key to the Mysteries of Physics and Metaphysics." The article is interesting as a revival of the once famous theory of mind-stuff put forward by W. K. Clifford in his lecture on "The Nature of Things in Themselves." Mr. Troland connects it with several recent philosophical theories of psychical monism and brings it forward with particular reference to the consequences of adopting the principle of relativity and the quantum theory in physics, both of which, he contends, demand the recognition of the ultimate psychical nature of physical reality.

The essence of the mind-stuff theory is that it supposes mind to be constituted and articulated, not merely on the analogy of physical reality but on one and the same principle, so that a parallelism runs throughout the universe between mind and matter. Every electron or proton has not only a psychical aspect but in its ultimate nature is a constituent of mind, a bit of mind-stuff. Just as the unit of physics, the electric charge, enters into combination in atoms, molecules, and their more or less stable compounds, acquiring thereby the various physical and chemical properties of things, so the mind-stuff combines to acquire the various sensational, emotional, and intellectual properties of personalities.

Mr. Troland's argument is interesting but scarcely convincing. He thinks by the theory to get over Berkeley's difficulty that no qualities of things, primary or secondary, are independent of the observing individual. The new realists, though they have recently attached Berkeley, have not, he thinks, succeeded as yet in developing an explanation of the universe which is either simple or plausible.

The difficulty of Mr. Troland's theory, however, if offered as a support of Einstein, would seem to be that it misses the essential difference between the activity of the observer co-ordinating events in space-time systems and the intersecting world-lines which present the events co-ordinated. The theory of knowledge we are waiting for in science as well as in philosophy is one which will give full meaning to the subjective and objective factors without sacrificing either to the other. Psychical monism seems to be no more successful than physical monism as a key to the mysteries of physics and metaphysics, but we commend Mr. Troland's argument, which includes in its scope recent physiological research as well as the new physical theories.

Technical Education.

THE annual conference of the Association of Teachers in Technical Institutions was held on June 5-7 in London, and in the course of his presidential address, Mr. J. Paley Yorke claimed very strongly that technical education is definitely education and is as essential as any other branch of educational activity. He said that technical education is essentially scientific education, and urged that the advance of scientific knowledge and the development of the applications of science to industry and manufacture have been so tremendous that the time has arrived when a special committee of inquiry should be appointed to investigate the whole field of technical education in relation to industry and to education generally. It is now forty years since there has been any national inquiry on technical

education, and during that time it has developed beyond the recognition of many of those who imagined themselves to be its guardians.

Mr. Paley Yorke protested against the charge of soullessness that is sometimes levelled at scientific education, and argued that it gives an extended vision and develops both imagination and that too rare gift of being able to marvel at the wonders of nature and to appreciate the beauties of life. It cannot be admitted that a good general education can be obtained only by the study of certain subjects in certain ways or that education and culture must be associated necessarily with bygone civilisations.

Reference was made to the fact that opportunity for contact with industry and for research is scant, and it was urged that directors of industry might submit some of their research problems to local Education Authorities and through them to the scientific and technical staffs of the various technical institutions in the area. It is realised, of course, that all problems would not arrive that way because of the publicity involved, but some useful work may be done.

Attention was also directed to the proposed reduction of grants for scientific research and to the reduction in the number of national scholarships for higher education. It was pointed out that not only do these reductions gravely imperil scientific and industrial development, but also that the percentage reduction in the estimates for these items is much greater than that for corresponding items in other branches of educational work.

Lord Burnham said that technical education is slowly gaining its right place in the assessment of national values. This country, with its superiority in industrial matters during the greater part of the nineteenth century, looked with supreme self-confidence upon the efforts of other nations to compete with us in industrial production. When the advance of scientific discovery showed that mere manual dexterity was not sufficient the necessity for technical education was admitted. Lord Burnham doubted whether there is any other class of teacher upon which the future prosperity of the nation depended so much. Technical teachers are striving to shape education for the public good and for the welfare of the generations which are coming to manhood.

Resolutions asking for the appointment of a committee of inquiry to investigate the whole field of technical education in relation to education generally and to industry, and expressing alarm at the reduction in the number and value of scholarships available for higher education, were carried unanimously.

University and Educational Intelligence.

BRISTOL.—The J. S. Fry and Sons, Ltd., Colston Research Fellowship, which provides for payment of fees and a maintenance allowance of 150*l.* a year, has been awarded to Mr. F. B. Wrightson, a student in the Faculty of Engineering.

CAMBRIDGE.—Mr. W. B. R. King, fellow of Jesus College, has been elected to be fellow and lecturer in natural sciences at Magdalene College; Mr. P. M. S. Blackett to be Charles Kingsley Bye fellow of Magdalene College; Mr. L. E. Bayliss, Trinity College, to be Michael Foster student in physiology; Mr. F. Lavington and Mr. J. Line, to be fellows of Emmanuel College; and Mr. J. A. Carroll to be fellow of Sidney Sussex College.

GLASGOW.—Mr. A. D. Lindsay has been appointed to the chair of moral philosophy in succession to the late Sir Henry Jones. Mr. Lindsay was formerly Shaw Fellow of the University of Edinburgh, and lecturer in philosophy at the old Victoria University. In 1906 he was elected Fellow of Balliol College, Oxford, and was appointed classical tutor and Jowett lecturer in philosophy.

LEEDS.—The Council has appointed Dr. W. T. David to be professor of civil and mechanical engineering in succession to Prof. J. Goodman, who retires in October next. Dr. David, who is at present professor of engineering at the University College of South Wales, was educated at Cardiff and Cambridge. He served as demonstrator in engineering under Prof. Bertram Hopkinson at Cambridge for two years, and later was appointed H.M. Inspector of Technical Colleges under the Board of Education. His research work has been concerned mostly with internal combustion engines.

The handsome gift received some little time ago from Col. Sir Edward Brotherton of 20,000*l.* has enabled the University to make an important development in the work of the department of pathology and bacteriology. Sir Edward's intention was that his gift should be devoted to the furtherance of the study of bacteriology with special reference to public health, and as a step in this direction the Council has instituted a new professorship to be called "The Sir Edward Brotherton Chair of Bacteriology." Dr. J. W. McLeod has been elected as the first holder of this chair. Dr. McLeod graduated with commendation at Glasgow University in the summer of 1908, and after acting as house physician at the Glasgow Royal Infirmary and house surgeon at the Glasgow Western Infirmary, gained the Coats research scholarship and worked for a year under Prof. R. Muir. Later he was appointed assistant lecturer and demonstrator in pathology at the Medical School of the Charing Cross Hospital, and afterwards lecturer in bacteriology at the University of Leeds. Dr. McLeod has carried out important research work in the field of bacteriology, and has published numerous papers dealing more especially with the bacteriology of influenza, dysentery, pneumonia, and the streptococcal infections.

LONDON.—At a meeting of the Senate on June 21, Mr. H. J. Waring, Dean of the Faculty of Medicine and vice-president of St. Bartholomew's Hospital Medical College, was elected Vice-Chancellor for 1922–23, in succession to Sir Sydney Russell-Wells. A cordial vote of thanks was passed to Sir Sydney Russell-Wells for the services which he had rendered to the University as Vice-Chancellor since December 1919.

Mr. J. H. Woodger was appointed to the University readership in biology tenable at Middlesex Hospital Medical School. Mr. Woodger was educated at University College, whence he graduated in zoology, and was awarded the Derby Research Scholarship. In 1917 he was appointed protozoologist to the Central Clinical Laboratory in Amarah, and in 1919 assistant in zoology at University College.

Sir Charles W. C. Oman, Chichele professor of modern history in the University of Oxford, was appointed Creighton lecturer for the year 1922–23. The subject of his lecture will be "Historical Perspective."

The Lindley studentship for 1922, of the value of 120*l.* and tenable in the Physiological Laboratory, has been awarded to Miss M. J. Wilson-Smith of Royal Holloway College; and the University studentship in physiology for 1922–23, of the value of 50*l.* and tenable in the Physiological Laboratory of the University or of one of its Schools, to Miss M. M. A. Murray of Bedford College.

MANCHESTER.—Mr. E. D. Telford, lecturer in practical surgery in the University, and a member of the Honorary Staff of the Manchester Royal Infirmary, has been appointed professor of systematic surgery.

BY the will of the late Sir William Lorimer, who died on April 9 last, the Court of the University of Glasgow will receive the sum of 10,000*l.*

IT is announced in *Science* that, by the will of the late Amos F. Eno, Columbia University, New York, will receive a bequest of about four million dollars.

THE Beaney Scholarship in Materia Medica at Guy's Hospital Medical School is vacant. It is of the yearly value of about 50*l.* and tenable for three years. It is open to candidates who have received at least part of their medical education at Guy's Hospital. The latest date for receiving applications is July 7. They should be sent to the Dean of the School, S.E.1.

THE Gull studentship in pathology and allied subjects, of the annual value of about 250*l.* and tenable for three years, is being offered by Guy's Hospital Medical School. The studentship is open to candidates under 35 years of age who have studied in the school. Applications must reach the Secretary to the Board of Electors, Guy's Hospital Medical School, S.E.1, by, at latest, July 7.

THE summer meeting of the Association of Technical Institutions will be held at Oxford on Friday and Saturday, July 7 and 8. The sessions on Friday and Saturday mornings will commence at 10.30 o'clock, when the president, The Right Hon. Walter Runciman, will occupy the chair. The Rev. L. R. Phelps, Provost of Oriel College and Pro-Vice-Chancellor, will welcome, on behalf of the University, the members of the association at the opening of the conference. Papers will be read by Rev. W. Hardy Harwood (Chairman of the Council) and Principal J. F. Hudson (Huddersfield) on "The Relation of Technical Education to the Question of General Education." Principal J. Quick, on "Central Schools and their part in the Preparation of Scholars for Higher Technical and Junior Technical Schools," and by Mr. E. C. Kyte, Secretary of the Library Association, on "Technical Libraries—How to Start and Develop them."

THE annual report of the Livesey Professor, Prof. John W. Cobb, at the University of Leeds, gives an account of the work done in the department of coal gas and fuel industries (with metallurgy) for the session 1920–21. The number of students (41) reached the highest figure in the history of the department; one third (14) taking the fuel and metallurgy course, the remainder (27) the course in fuel and gas engineering. The special evening classes included courses on the distribution of gas (Mr. Walter Hole), coke oven practice (Mr. W. Greaves), steaming in vertical retorts (Dr. A. Parker), and metallurgy (Mr. P. F. Summers). These courses were attended by 49 external students in addition to the full-time registered students. Researches were carried out on the liberation of nitrogen from coal and coke as ammonia, the structures of cokes prepared at different temperatures, the losses of ammonia in coke oven practice, a laboratory apparatus for coal distillation, the expansion of refractory materials, the trustworthiness of recording gas calorimeters, and the efficiency of production of blue water gas. The endowment funds of the department have benefited by substantial donations from the South Metropolitan Gas Company, the South Suburban Gas Company, and from Mr. A. G. Glasgow.

Societies and Academies.

LONDON.

Royal Society, June 15.—Sir Charles Sherrington, president, in the chair.—H. M. **Evans**: The defensive spines of fishes, living and fossil, and the glandular construction in connexion therewith, and observations on the nature of fish venoms. The gland in the groove of the spine of the sting-ray (*Trygon pastinaca*) consists of two portions—the deepest part of the groove contains an alveolar-connective tissue structure, which is separated from the true glandular epithelium by a pigmented capillary layer. The dorsal fin-spines of the spiny dog-fish Acanthias are grooved, and the groove is occupied by a gland with definite follicles. Cestracion also has a well-developed gland at the base of the dorsal fin spines. The spines of Chimæra and of the Pleuracanthidæ show structures which suggest a specialised function. The nature and properties of Weever venom are described; the filtration of venom profoundly affects its hæmolytic properties. Experiments are described on the native use of abrin as an antidote to fish venoms.—D. W. **Cutler**, L. M. **Crump**, and H. **Sandon**: A quantitative investigation of the bacterial and protozoan population of the soil: with an account of the protozoan fauna. The results of 365 consecutive daily counts of the numbers of bacteria and of six species of protozoa in a natural field soil are given. Large fluctuations occur which cannot be correlated with meteorological conditions. Fourteen-day averages of the daily numbers show marked seasonal changes superimposed on the daily variations in numbers. In general, both bacteria and protozoa are most abundant at the end of November, and fewest during February. The changes are not directly influenced by temperature or rainfall. An inverse relationship is found between the numbers of bacteria and certain amœbæ, and a two-day periodicity obtains for the numbers of the flagellate *Oicomonas termo* which are active.—D. W. **Devanesen**: The development of the calcareous parts of the lantern of Aristotle in *Echinus miliaris*. All the calcareous elements of the lantern of Aristotle, with the exception of the teeth, are deposited as triradiate spicules. A "compass" arises from two rudimentary spicules. It is the only element of the lantern absent in the "echinus-rudiment." A tooth is a paired structure in consequence of its composition of a double row of lamellæ. A pair of lamellæ is its ultimate unit. A remarkable stage in the consolidation of these lamellæ is the cone-in-cone arrangement. The carina is formed by the beaks of the serially fitting cones. The ossicles of the lantern are compared with those of the mouth-frame of star-fish.—A. **Lipschütz**, C. **Wagner**, R. **Tamm**, and F. **Bormann**: Further experimental investigations on the hypertrophy of the sexual glands.

Zoological Society, June 13.—Prof. E. W. MacBride, vice-president, in the chair.—Miss J. B. **Procter**: A study of the remarkable tortoise *Testudo loveridgii* Blgr., and the morphogeny of the Chelonian carapace.—J. T. **Carter**: A microscopical examination of the teeth of the primates.—H. G. **Jackson**: A revision of the isopod genus Ligia, Fabricius.—W. R. B. **Oliver**: A review of the Cetacea of the New Zealand seas.—F. Wood **Jones**: On the dental characters of certain Australian rats.

Linnean Society, June 15.—Dr. A. Smith Woodward, president, in the chair.—A. B. **Rendle**: Seedlings of horse-chestnut from which the terminal bud had been removed by cutting through the epicotyledonary stem. Minute buds appeared on the cut surface corresponding in position with the cambium-

layer in the stem. A new shoot was also produced in the axil of each of the cotyledons.—Sir Arthur **Shipley**: *Furia infernalis*. Linnæus was probably stung by a virulent insect which may have conveyed to his system some pathogenic germs unknown at that time.—T. A. **Sprague**: The identification of *Sison Ammi*, Linn. *Sison Ammi* is an umbelliferous plant published by Linnæus in the first edition of the "Species Plantarum" in 1753. The type-specimens in the Linnean Herbarium and the British Museum show that it is *Carum copticum*, a medicinal plant which yields the Ajowan seeds and Ajowan oil, from which thymol is obtained. The history of the drug Ammi goes back to Dioscorides, who lived in the first century of the Christian era; he described it as having a minute seed with the flavour of marjoram. Various plants have been described as the Ammi, but in the plates of Umbelliferæ published by Rivinius at the end of the seventeenth century, the officinal Ammi is *Carum copticum*. The geographical source of the drug supports this conclusion. The best quality of Ammi was imported from Alexandria, but was actually grown in Arabia, where *Carum copticum* is still cultivated. It has never been found in a wild state.—E. A. Newell **Arber**: Critical studies of coal-measure plant impressions. The British Upper Carboniferous species of the genus Lepidostrobus, Brongn., preserved as incrustations, and other impressions were discussed.—J. **Burtt-Davy**: A revision of the South African species of Dianthus. Thunberg's specimen of *D. incurvus*, Thunb., does not match any South African material at Kew or the British Museum. Thunberg himself identifies it on the sheet with *D. albens*, Ait., but the specimen does not agree with the type of *D. albens* in the British Museum. In the "Flora Capensis," Sonder recognised nine species of Dianthus. Of these, seven only are valid, and to them must be added four species not recognised by Sonder. Six additional species and three varieties are now described, bringing the total number up to seventeen species and three varieties.

Royal Meteorological Society, June 21.—Dr. C. Chree, president, in the chair.—J. E. **Clark**, H. B. **Adames**, and I. D. **Margary**: Report on the phenological observations for the year 1921. After mid-December the mildness until late March was extreme, which gave premature fruit blossom and its usual concomitant of poor fruit crops, except apples. The four early spring flowers were more than 18 days earlier than the 30 years' mean; April and May, 14 days, June, 10, and July, 6 days. Grain-cutting was very early. The warm uprush along the Bristol Channel, and up the Severn and Dee valleys to include the Wirral Peninsula, was almost identical with the isophenal trend and values for 1920. In the north-east of Norfolk there was a recurrence of the cold area so well marked in the years 1919 and 1920, spreading southward from the North Sea, and curving south-eastward by Norwich to include Bungay, and also of the long tongue stretching from the Scottish border southward to include Leicestershire and Rutland. The northerly bulge of warmth just north of the Isle of Wight was again very definite. High ground is, as before, indicated on the maps by relatively late isophenal areas. Among exceptional effects were the brief blooming period of the summer flowers and the earliness of the autumn flowers, especially the Michaelmas daisies; the dormant or destroyed seed-sowing experiences; the frequency of second blossom after the August rains, typically the horse-chestnut; the early departure of the swallows; the dearth of tortoiseshell and allied butterflies, apparently from lack of nettles. October had a week of unparalleled heat, while November opened with severe frosts. After a partial fall in late July, trees had retained their foliage to an unusually late date, and those frosts had the effect of making many of the leaves brown and shrivelled as if from excess of heat. Planes and elms kept their green leaves almost or quite until December.—L. F. **Richardson**, A. **Wagner**, and R. **Dietzius**: An observational test of the geostrophic approximation in the stratosphere. Wind velocity, at points not too near the earth's surface or the equator, may be found with an accuracy of about 5 per cent. from the horizontal pressure gradient and the rotation of the earth. A test of the error involved in neglecting other considerations is obtained by inserting the "geostrophic" velocities in the equation for the accumulation of mass. Thus a theoretical equality, valid in the stratosphere, between certain derivatives of wind and temperature is obtained. From observations collected by Wagner and Dietzius, the quantities which this theory makes equal have a positive correlation of about four-tenths.

EDINBURGH.

Royal Society, May 8.—Prof. W. Peddie, vice-president, in the chair.—Prof. E. T. **Whittaker**: The quantum mechanism in the atom (see p. 23).—A. R. **Forsyth**: Differential invariants and other concomitants of quadratic differential forms in four variables. The method is that of Lie's continuous groups, and is thus entirely different from the Christoffel method usually expounded. It provides new results which the Christoffel method did not even suggest. It can be applied to obtain Einstein's critical form in the relativity theory of gravitation; on one hand, some of his conditions were covered by others, and on the other hand his form satisfied one equation more than the set he initially postulated.—T. R. **MacRobert**: The asymptotic expansion of the confluent hypergeometric function, and the Fourier-Bessel expansion.

PARIS.

Academy of Sciences, June 6.—M. Emile Bertin in the chair.—Ch. **Boulanger** and G. **Urbain**: The composition and chemical characters of thortveitite from Madagascar. Five complete analyses of this mineral are given. The proportion of yttrium earths does not exceed 0·5 per cent., while the Norwegian mineral contains 4-18 per cent. Of this group only yttrium, neoytterbium, and lutecium could be detected.—MM. **d'Arsonval**, **Bordas**, and **Touplain**: Study of the glacier waters of Argentière and Bossons. There are marked differences in the electrical conductivity and chemical composition of the waters from these two sources.—Carl **Stormer**: Determination of the external magnetic field of the sun by the structure of the solar corona and the constants of the aurora borealis.—Louis **Roy**: Electromagnetic actions in an isotropic system.—G. **Reboul**: A new radiation and its application to the study of the ultraviolet of Millikan and Lyman.—A. **Tian**: Thermostats with multiple jackets. The copper vessel containing the liquid to be maintained at a constant temperature, is surrounded with felt and placed in one or more boxes, also of copper, which are isolated in the same manner. The external jacket is heated, and a uniform, steady temperature can be thus maintained without stirring. The advantages claimed for this system are that the thermal oscillations due to the regulator are almost entirely eliminated. The temperature of the inside bath is practically independent of variations in the room temperature, and stirring is not required.—Léon and Eugène **Bloch**: Spark spectra in water.

The photography of spectra of sparks under water, by the automatic separation into arc lines and spark lines and by the differences in the appearance of the lines, appears to be valuable in detecting spectral regularities.—M. de **Bellescize**: Damping the oscillations of resonators in wireless telegraphy.—A. **Recoura**: Some new properties of the green sulphate of chromium. Green sulphate of chromium forms complex compounds with potassium sulphate, and the resulting solutions give reactions with benzidine compounds or with barium chloride, indicating that SO_4 ions are absent or present in small proportions only. Results are given of a study of the effects of temperature, dilution, and time on these complexes.—Paul **Riou**: The velocity of absorption of carbon dioxide by alkaline solutions.—Mlle. **Wurmser**: The preparation of ammonium nitrate. An extension of earlier work by M. Rengade on the formation of ammonium nitrate by the interaction of sodium nitrate and ammonium chloride.—Mlle. N. **Wolff**: Furfural-α-methylcyclohexanone and some of its derivatives. Mono- and difurfuralcyclohexanones.—E. **Berger**: A formal lamp. A detailed account, with diagrams, of the construction of a new lamp for burning methyl alcohol to formaldehyde. With copper oxide as a catalyst the yield is 25-30 per cent. with silvered asbestos, 35-45 per cent. of the alcohol used is obtained as formaldehyde. Results of the application of the lamp to practical disinfection of rooms are given.—H. **Joly**: The tectonic direction of the Cretaceous and Tertiary deposits in the neighbourhood of Haro (Logroño, Spain).—P. **Lory**: The glacial stages and a valley recording these stages (Bédinat, Chaîne de Belledonne).—P. L. **Mercanton**: The glacial system of the Beerenberg of Jan Mayen. This extinct volcano was climbed by the author, with J. M. Wordie and T. Lethbridge, in August 1921. From the highest point (about 2500 metres) the structure of the crater was made out, and a detailed account of this and the glacier system is given.—MM. **Pons** and **Rémy**: The reddish-brown coloration shown in March 1922 by the Briançon snow. Specimens of the coloured snow, collected on March 19 at an altitude of 2350 metres, were examined, after melting, chemically and microscopically. There was practically no organic matter, and the microscope showed no remains of microscopic organisms (Algæ, Foraminifera, diatoms), nor were there any vitreous inclusions characteristic of volcanic dust. Chemical analysis showed silica, iron, and alumina. The possible origin of the dust is discussed, but no definite conclusion could be arrived at.—P. **Bugnon**: The fibrovascular organisation in Mercurialis. Possible descent from a primitive form.—Gustave **Chauveaud**: The principal variations in the vascular development of the first phyllorhiza of Phanerogams are not determined by intercalary increase.—Louis **Lapicque**: Mechanism of the exchanges between the cell and the surrounding medium. The osmotic pressure in the cells of marine Algæ is higher than that of sea water. This is incompatible with the currently accepted view that all exchanges of the cells are determined by the laws of osmosis. The author holds that, on the contrary, the exchanges of the cells are the result of physiological work and that diffusion and osmotic pressure intervene often as resistances only.—Paul **Portier** and Marcel **Duval**: The variation of the osmotic pressure of the blood of the cartilaginous fishes under the influence of modification of the salinity of the surrounding sea water. The dog-fish was used in these experiments, and it was found that the osmotic pressure of the blood was not equal to that of the sea water in which the fish is immersed. There was a tendency for the osmotic pressure of the blood to follow that of the sea water, but the adjustment was very imperfect. The fish supported dilution of sea water better than enrichment with salt.—E. **Fauré-Fremiet** and Mlle. H. **Garrault**: Constitution of the ovarian egg of the carp (*Cyprinus Carpio*).—H. **Vallée** and H. **Carré**: The plurality of the aphthous virus.

BRUSSELS.

Royal Academy of Sciences, June 3.—M. A. Lameere in the chair.—F. **Swarts**: On trifluormethylcyclohexane.—F. **Swarts**: On trifluoracetic acid.—Th. **De Donder**: The electromagnetic field and the gravific field.—A. **Mélant**: The conditions determining the encystment of the infusorian, *Euplotes harpa*.—M. **Philippson**: A new form of electrical resistance of electrolytes.—M. **Nuyens**: A change in the variables of M. De Donder.—P. **Bruylants** and J. **Dondeyne**: The determination of the atomic weight of selenium.

Official Publications Received.

The Mellon Institute of Industrial Research of the University of Pittsburgh. Ninth Annual Report on the Industrial Fellowships of the Mellon Institute for the Institute's Fiscal Year, March 1, 1921, to March 1, 1922. Pp. vi+23. (Pittsburgh, Pa.)

South Australia: Department of Mines. Mining Review for the Half-Year ended December 31st, 1921. Compiled by Lionel C. E. Gee. No. 35. Pp. 72. (Adelaide.)

South Australia. Department of Mines: Geological Survey of South Australia. Bulletin No. 9: The Iron-Ore Resources of South Australia. By R. Lockhart Jack. Pp. 71. (Adelaide.)

Bureau of Education, India. Occasional Reports No. 10: Adult Education (University Extra-Mural Teaching in England and Wales). By J. P. Bulkeley. Pp. ix+98. (Calcutta: Government Printing Office.) 8 annas.

Bureau of Education, India. Indian Education in 1920–21. Pp. ii+87. (Calcutta: Government Printing Office.) 1.8 rupees.

Technical College, Bradford. Diploma and Special Day Courses. Prospectus, Session 1922–23. Pp. 168+plates. (Bradford.)

Report of the Fifteenth Meeting of the Australasian Association for the Advancement of Science. Hobart Meeting, held in Melbourne, January 1921. Edited by Dr. Georgina Sweet and Dr. A. C. D. Rivett. Pp. lxxxix+390. (Sydney, N.S.W.: The Association, Elizabeth Street.)

Diary of Societies.

FRIDAY, JUNE 30.

ASSOCIATION OF ECONOMIC BIOLOGISTS (at the Royal Horticultural Society's Gardens, Wisley), leaving London 11.15–11.30 A.M.—Annual Field Meeting.

ROYAL SOCIETY OF MEDICINE (Laryngology Section), at 4.45.

MONDAY, JULY 3.

VICTORIA INSTITUTE (at Central Buildings, Westminster), at 4.30.—Right Rev. Bishop Welldon: Modernism. (Annual Address.)

FELLOWSHIP OF MEDICINE (at Royal Society of Medicine), at 5.—Dr. J. S. Goodall: So-called Functional Diseases of the Heart.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.—General Meeting.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.—Dr. T. Ashby: Recent Excavations at Rome.

ARISTOTELIAN SOCIETY (at University of London Club, 21 Gower Street), at 8.—W. O. Brigstocke: Probability.

TUESDAY, JULY 4.

EUGENICS EDUCATION SOCIETY (Annual General Meeting) (at Royal Society), at 5.30.—Dr. Tredgold, Dr. C. H. Bond, Dr. B. Hollander, R. A. Fisher, and others: Conference on the Inheritance of Mental Qualities, Good and Bad.

INSTITUTE OF PHYSICS (at Institution of Electrical Engineers), at 5.30.—Sir Alfred Ewing: The Physicist in Engineering Practice, with Special Reference to Applications of Thermodynamics. (Lectures on "Physics in Industry" (2).)

SOCIOLOGICAL SOCIETY (at Leplay House, 65 Belgrave Road), at 8.15.—S. C. Ramsey: Regional and Vocational Influences on Architecture.

WEDNESDAY, JULY 5.

ROYAL METEOROLOGICAL SOCIETY (a Summer Meeting) (at the Croydon Aerodrome), at 3.—G. R. Hay: Address on the Arrangements for supplying Meteorological Information to Pilots.—Inspection of Aerodrome, etc.

THURSDAY, JULY 6.

ROYAL SOCIETY OF MEDICINE, at 5.—Annual General Meeting.

CIVIC EDUCATION LEAGUE (at Leplay House, 65 Belgrave Road), at 8.15.—A. Farquharson: Art as a Mirror of Society.