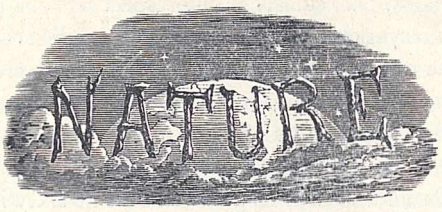

SATURDAY, AUGUST 12, 1922.

CONTENTS.

	PAGE
Universities of Oxford and Cambridge Bill	201
Paracelsus. By Sir T. E. Thorpe, C.B., F.R.S.	202
The History of British Agriculture. By Sir E. J. Russell, F.R.S.	204
Ore Deposits. By Prof. H. Louis	205
The Living Soil	206
The Presentation of Thermodynamics	207
Dialectic. By Prof. H. Wildon Carr	208
The Methods of Ecological Investigation. By Dr. E. J. Salisbury	208
Avian Minstrelsy	209
Our Bookshelf	210
Letters to the Editor :—	
The Cause of Rickets.—Sir W. M. Bayliss, F.R.S.; The Writer of the Article	212
The Phenomena and Conditions of Sex-change in the Oyster (*O. edulis*) and Crepidula.—Dr. J. H. Orton	212
Wegener's Displacement Theory.—E. R. Roe-Thompson	214
The Elliptic Logarithmic Spiral.—H. S. Rowell	214
Pairing and Parthenogenesis in Saw-flies.—A. D. Peacock	215
Some Significant Relations in the Quantum Theory of Spectra.—Satyendra Ray	215
Extraction of Radiolaria from Oozes.—H. L. Thomas; Arthur Earland	216
An Attempt to Influence the Rate of Radioactive Disintegration by Use of Penetrating Radiation.—Dr. G. Hevesy	216
Black Coral. By Prof. Sydney J. Hickson, F.R.S.	217
The Determination of Stellar Distances. (*With diagram.*) By Dr. William J. S. Lockyer	219
Short-wave Directional Wireless Telegraph. By C. S. Franklin	220
Obituary :—	
Prof. W. Wislicenus. By J. F. T.	223
Dr. A. G. Mayor	224
Dr. Alexander Graham Bell. By A. R.	225
Current Topics and Events	226
Research Items	228
The "Immured Standards" in the House of Commons	230
The International Research Council	230
The Philosophical Congress at Manchester	231
The Congress of the Royal Sanitary Institute	232
Pharmaceutical Education and Research	233
University and Educational Intelligence	233
Calendar of Industrial Pioneers	234
Societies and Academies	235
Official Publications Received	236

Editorial and Publishing Offices :
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Advertisements and business letters should be addressed to the Publishers.
Editorial communications to the Editor.

Telegraphic Address: PHUSIS, LONDON.
Telephone Number: GERRARD 8830.

Universities of Oxford and Cambridge Bill.

WHEN some three years ago the Universities of Oxford and Cambridge applied to Parliament for an annual grant to meet recurring expenses it was obvious that such aid could be given only after due inquiry. Accordingly a Royal Commission was appointed on November 14, 1919, "to enquire into the financial resources of the Universities and of the Colleges and Halls therein, into the administration and application of those resources, into the government of the Universities, and into the relations of the Colleges and Halls to the Universities and to each other." On March 24 of the present year the report of this commission was published, and as a direct result we have the Bill which was introduced by Mr. Fisher, president of the Board of Education, into the House of Commons on July 24.

The Bill is short, consisting of ten sections, with a schedule embodying certain provisions of the Universities of Oxford and Cambridge Act, 1877, adapted for present purposes. Two bodies of commissioners are to be set up, styled respectively "The University of Oxford Commissioners" and "The University of Cambridge Commissioners." The commissioners are named and comprise men representative of the varied aspects and interests of university life. Their tenure of office is temporary and will normally expire at the end of the year 1924, but may on the application of the commissioners themselves be continued by His Majesty in Council for other two years. From and after January 1, 1924, these commissioners will "make statutes and regulations for the University, its colleges and halls, and any emoluments, endowments, trusts, foundations, gifts, offices, or institutions in or connected with the University in general accordance with the recommendations contained in the Report of the Royal Commission, but with such modifications as may, after the consideration of any representations made to them, appear to them expedient."

After the termination of the powers of the commissioners the universities and colleges will again assume their own government, but notice of any proposed statute for a college must be given to the university before it is submitted to His Majesty in Council, and any college statute which affects the university may not be altered without the consent of the university. Again, except with the consent of the trustees or governing body, no trust may be altered "unless fifty years have elapsed since the date on which the instrument creating the trust came into operation." This, however, will not operate against increasing the endowment of any emolument. Further, the contributions of the colleges to university purposes must be assessed in

the first place with regard to the needs of the colleges themselves.

The schedule deals with such questions as the interim powers of the universities and colleges; the provision that the commissioners in framing statutes "shall have regard to the interests of education, religion, learning, and research; the election of college representatives as commissioners; and procedure generally and other matters of detail.

Obviously the Bill must be read in the light of the Report. The institution of two bodies of commissioners is the result of a recommendation in it "that a Statutory Commission should be set up to carry out the changes recommended," and the powers of these two bodies are defined, except in special circumstances, by it. As we have remarked in a previous article in these columns the Report is distinctly conservative. Similarly, the Bill, for example in its provision for dealing with trusts and endowments, shows clearly that there is no intention of making sweeping changes. The new commissioners hold office for a season; the suspension of the autonomy of the universities is merely temporary.

The new bodies have no easy task before them. The problems will demand knowledge, skill, and tact. The question of the reform of the government of the university requires delicate handling. The colleges must be brought into closer relationship with the university. The teaching will have to be reorganised and co-ordinated, and proper provision made for research and advanced work. Fellowships, scholarships, extra-mural education, cost of living in colleges, non-collegiate students, and entrance examinations are some of the questions to be dealt with. In addition, there are the twin problems of salaries and pensions. Here it may be expected there will be difficulties. Notwithstanding all that has been done in recent years in the modern universities these are problems still unsolved there. The question is not an easy one. For the Cambridge Commission there is the further question of the position of women in the university.

The projected reforms can be effected only by a large increase in the income of the two universities. The Report recommends an annual Parliamentary grant of 100,000*l.* to each university. Such a sum is none too great for carrying into effect its financial proposals. At present the grant is 30,000*l.* to each, and doubtless a further instalment in the immediate future is contemplated. This raises the important question as to whether or not Oxford and Cambridge should have separate and individual consideration in the matter of State aid apart from the modern universities. In some respects it is right and proper that separate and individual consideration should be given to these ancient institutions, particularly if due respect is to be paid to the conservation of the best of their traditions. But the case is not on all fours where finance is concerned. Until recently the modern universities had been treated somewhat scurvily by the State, and even now they receive only 1,200,000*l.* of an annual Parliamentary grant for allocation among something like sixty institutions. The largest individual grant for the year 1921–2—that received by the Imperial College of Science and Technology—amounts to 67,500*l.*, a sum in our opinion quite inadequate for the expansion and development of an institution of this standing. Moreover, when the amounts allotted to the other institutions of university rank are considered in detail, it is clear that a sum of 200,000*l.* for Oxford and Cambridge is quite out of proportion. The modern universities are not receiving the financial help from the State to which they are entitled, and, in particular, at the very time when Oxford and Cambridge are receiving for the first time an annual grant of 60,000*l.*, they are being deprived of an annual grant of 300,000*l.* This withdrawal cannot be justified. In point of fact the financial difficulties of the modern universities are equally as great as, if not greater than, those of the two older universities.

The question of Parliamentary grants to our universities should be considered as a whole and not piecemeal. In the light of seemingly contradictory statements made in public regarding State aid given to the modern universities it would appear that the whole question should be discussed in Parliament. It is not true, except as a mere technicality, to say that the annual grant to the modern universities will remain at its present level. Any one who takes this statement at its face value will have a rude awakening in the coming financial year. In our opinion, in such circumstances, it would be a mistake to consider the financial needs of Oxford and Cambridge apart from those of the modern universities. The position of the whole of the universities in the United Kingdom should be considered together, and not simply the position of two of them however ancient and honourable their traditions.

Paracelsus.

Theophrastus Bombastus von Hohenheim, called Paracelsus: His Personality and Influence as Physician, Chemist, and Reformer. By Prof. J. M. Stillman. Pp. viii + 184. (Chicago and London: The Open Court Publishing Co., 1920.) 10*s.* net.

AS is well known, it is the customary lot of revolutionaries, whether in politics, religion, literature, or science, or indeed in any department of intellectual activity, to be both vilified and extolled, and the

praise and the blame are usually administered in very unequal measure, and with no due regard to the intrinsic merits of the recipient. The common instinct of mankind is to oppose change, and he who sets himself athwart the general tendency to consider whatever is is right is certain to reap abuse for his pains, and to have his motives, however well meant, misrepresented and traduced. History shows that most reformers are in advance of their age. It is rarely that they hit what is mistakenly called the psychological moment—that is, when the world is ripe for the change they advocate, and willing and even eager to see it effected. In this exceptional case the reformer is extolled, his service universally acclaimed, and his immediate fame assured. The pioneer who has to face the *vis inertiae* of his age may, and usually does, go down to his grave "unwept, unhonoured, and unsung." It is only when the fermenting leaven he has laboured to introduce has, it may be after many years, produced its effect, that his effort is recognised and its results appreciated.

Such was the fate of him who is the subject of the work under notice. No man of his epoch was so systematically and so consistently disparaged, abused, and reviled as Theophrastus von Hohenheim, commonly called Paracelsus. His true vocation was that of a medical practitioner, and the head and front of his offending was that he should have striven to enlarge the scope of the medical system of his time—not simply by opposing the time-honoured doctrine of Hippocrates and Galen, as authorised by all the medical faculties of the period in every University of Europe—but by seeking to graft on to it newer conceptions and a wider and more rational scheme of therapeutics.

Paracelsus is frequently regarded as a chemist, and he certainly has his place in the history of chemistry. But he made no cardinal discovery in that science, and his name is not associated with any process or apparatus in operative chemistry. He wrote no treatise exclusively concerned with chemistry. He led a restless wandering existence, travelling, according to his own account, over nearly the whole known world, picking up and mentally storing the medical *arcana* of the various countries he traversed.

During the forty-eight troubled years of his chequered life Paracelsus certainly acquired a considerable knowledge of the chemical arts of his time; he writes familiarly of certain chemical processes, and shows acquaintance with the properties and uses of a fairly wide range of manufactured products. His great service to chemistry was that he was among the earliest to point out that the work of the professed chemists of his epoch was on wholly wrong lines. The ostensible objects of alchemy were illusory. In conceiving the possibility of transmutation the alchemists were imagining a vain thing. The true and proper function of the chemist was to serve humanity by preparing and studying the properties of substances of natural and factitious origin with a view of applying them in the treatment and cure of disease.

By thus creating the school of iatro-chemistry Paracelsus enlarged greatly the field of chemistry and extended enormously the scope of its operations. But, strictly speaking, Paracelsus only reverted thereby to the practice of the Arabian followers of Galen—Avicenna, Averrhoës, and their immediate followers—who taught that chemistry was the true hand-maiden of medicine. Their precepts had been misinterpreted and corrupted by a succession of commentators—mostly scholastics—who had imported into their teaching a leaven of mysticism and occultism altogether foreign to the spirit of Galen. Erasmus said of the medical system of his time that the whole art as they practised it was but an incorporated compound of craft and imposture.

The reform of medicine was part of the general movement of the Renaissance, and Paracelsus was as much a product of the period as Leonardo da Vinci, Copernicus, Thomas More, Luther, Vesalius, and the other progenitors of that great awakening. He created not only a new departure in chemistry, but he infused a new spirit into medical teaching and practice, and his reward was to suffer the slings and arrows of outrageous fortune in obloquy, poverty, and occasional starvation. He was fighting against the *Zunftgeist* of his age, against powerful corporations and strongly entrenched vested interests. Although he fell in the unequal struggle he was not beaten, for the spirit he invoked lived after him and eventually triumphed.

Paracelsus was a highly complex character—a strange compound of genius and folly, of ill-regulated life and unstable habits. It is this complexity of nature which is doubtless at the basis of the very divergent estimates which his various biographers have formed of him. He had all the defects of his qualities, and to a great extent he brought his misfortunes upon himself. He was of a rash, unbalanced disposition, impetuous, impatient of contradiction, a hard-hitter, and prone to intemperate language. Of course, he was stigmatised as a quack and a charlatan, and it must be admitted there were incidents in his career which afforded ground for the imputation. He seems to have treated the reproach with a contemptuous indifference which afforded no sufficient answer to his adversaries and no real satisfaction to his few followers and friends.

In spite of much that has been written concerning him Paracelsus remains an enigma, and his memory still suffers from the obloquy which was heaped upon

him during his life. Of late years there has been a tendency to seek to do him fuller justice and to put a more liberal and more kindly interpretation upon his conduct and actions, and to place him in what is to be regarded as his true relation to his epoch. Prof. Stillman's book is the latest attempt at his rehabilitation. It is a scholarly contribution to a subject which has still its perplexities and difficulties. The story of his life is here told without bias, dispassionately, and in the light of all available information, and the result is an eminently readable monograph written in the true spirit of history.

T. E. THORPE.

The History of British Agriculture.

(1) *English Farming: Past and Present.* By the Rt. Hon. Lord Ernle. Third edition. Pp. xvi + 504. (London: Longmans, Green and Co., 1922.) 12*s.* 6*d.* net.

(2) *A Short History of British Agriculture.* By John Orr. Pp. 96. (London: Oxford University Press, 1922.) 2*s.* 6*d.* net.

(1) THE story of British agriculture is for the greater part of its course the story of the life of the ordinary Briton, for until the industrial and commercial era began a century ago the country was in the main agricultural. Several histories have appeared, but none is more attractive than the volume written by Lord Ernle, which has now reached its third edition. There are few records of actual farming prior to the Norman invasion, and the account here given begins practically in the thirteenth century, though there is no reason to suppose that any great change had been brought about in agricultural methods for a long while previously. From that time onwards, however, the story is continuous, though it has had to be pieced together from manorial records, old country sayings, illuminated MSS., and many other sources. Lord Ernle has done his work remarkably well, and he traces with great clearness the changes from the old open field system, through the enclosures of the sixteenth, seventeenth, and eighteenth centuries, to the great changes introduced in the nineteenth century, and finally to our own times.

The edition before us differs from the previous one in that it contains a chapter on war farming in 1914–1918. This was an essay in State control, and the measure of its unpopularity in the countryside was seen in the almost savage joy with which the wholesale retrenchment of the numerous inspecting officials after the war was hailed, and in the irresistible demand for the removal of all restrictions on freedom of cropping and of farm management. Whatever the urban voter may elect to bear in the way of State control of industry, it is perfectly certain that the countryman will have none of it: he is an incorrigible individualist.

Space does not allow of an adequate quotation from the account of the history of those eventful days. Lord Ernle has the double advantage of inside knowledge and of freedom from any restriction in relating the course of events, and he tells the story vividly. The real agricultural difficulty began in 1917, after the harvest of 1916. The Board of Agriculture had foreseen this and had prepared a scheme, but the Cabinet had not put it into operation. The winter 1916–17 was very unfavourable to the agriculturist; the supply of men, of feeding-stuffs and of fertilisers was short, and was diminishing, and farmers generally were losing heart. State control became imperative. The method adopted was probably as good as could be devised, and very full powers were given to the large body of experts brought in for the purpose. In spite of all its disadvantages and the increasing difficulties in regard to labour and materials, the system was successful in producing certain items of human food, as the following table proves:

Crops.	1918.	1916.	1904-13.	Increase.		Percentage of Increase.	
				Over 1916.	Over 1904-13.	Over 1916.	Over 1904-13.
(In Thousands of Quarters.)						%	%
Wheat . .	10,534	6,835	6,653	3,699	3,881	54	58
Barley . .	6,085	5,181	6,212	904	−127	17	−2
Oats . . .	14,336	10,411	10,572	3,925	3,764	38	36
Mixed Corn .	*620	*..	*..	620	620	..	..
Beans and Peas . .	1,328	1,122	1,529	206	−201	18	−13
Total. . .	32,903	23,549	24,966	9,354	7,937	49	32
(In Thousands of Tons.) Potatoes.	4,209	2,505	2,643	1,704	1,566	68	59

The present writer can testify, however, that the machine was kept going only by constantly reminding the rural community of the men in the trenches, and had it not been for the poignant sorrow and bitter tragedy of the war no power on earth would have kept the farmers to the programme. It is not that they are less patriotic than others, quite the contrary. But the system is not suited to the conditions of the countryside and so it lacks permanency. Post-war agriculture is adjusting itself to post-war economic conditions.

The volume is full of interest and will certainly appeal to a large body of readers.

(2) Teachers of agriculture generally will welcome the appearance of a little book on the history of the subject which they can place in the hands of their students, in the first instance to stimulate their interest, and afterwards as an introduction to larger works.

* Mixed corn is shown separately in 1918. In previous years it is shown under wheat, barley, or oats.

Mr. Orr's book can confidently be recommended for this purpose.

The book is simply written and can be read without any extensive knowledge of English history: it is unbiassed and, for its size, it gives as good an account as we have yet seen of the course of events in British farming from the earliest times to the present day. The illustrations are excellent and well chosen from a wide range of sources: they show, side by side, the older and the newer types of implements or of animals, and afford admirable demonstrations of the great changes that have taken place since agriculture began to develop.

In discussing the post-war period Mr. Orr ends on a note of subdued optimism which we hope and believe is justified: "The market for farm produce is weak. Agriculture must share the bad fortune as well as the good fortune of the country and even of the world. In view of the magnitude of the war its evil effects will probably be very great and very prolonged. But however difficult times may be, there is promise for the future in the better feeling that exists between landlords and tenants, employers and employed, as compared with that which prevailed a century ago. There has been no poor-law payment of wages, and the difference between the treatment of the labourer then and now is an indication of the progress that has been made."

E. J. RUSSELL.

Ore Deposits.

Abriss der Lehre von den Erzlagerstätten: In Anlehnung an die dritte Auflage des Lehrbuches und unter Benützung hinterlassener Aufzeichnungen. Von Prof. Richard Beck. Bearbeitet durch Georg Berg. Pp. xi + 408. (Berlin: Gebrüder Borntraeger, 1922.) 16*s.* 8*d.*

AS is stated by Dr. Berg in his introduction, this work, an abstract of the study of ore deposits, is an abbreviation of the large work in two volumes by Richard Beck. The original work was well known, and three editions have been published since it was originally issued in 1900. The general principle of classification remains nearly the same as that in the original work, and it must be admitted that, generally speaking, the changes that have been made have not made for a clearer understanding of this exceedingly complex subject.

As in the original, a clear cut is made between epigenetic and syngenetic deposits; the author defines these phrases as follows: in the former he includes deposits into which ore has been introduced only after the formation of the immediately adjoining country rock, while the latter term is restricted to magmatic segregation in which the ore is formed simultaneously with the country rock. These basal definitions, however, are by no means satisfactory. The author's definition excludes from the syngenetic group sedimentary deposits, such as beds of ironstone deposited originally as bog ironstone, etc., and in fact Dr. Berg has treated such deposits quite separately from his syngenetic deposits and has placed them in his classification after the epigenetic deposits. Dr. Beck, on the other hand, looked upon such ores as syngenetic, and there is no doubt that his view is the sounder and leads to a clearer understanding of the entire subject.

Again, Dr. Berg devotes a separate section to the Gozzans or alteration products of existing ore deposits, formed above permanent water level, which may include both secondary enrichment and impoverishment of the deposits in respect of their metallic contents. He classifies these deposits as epigenetic on the grounds that certain deposits are in themselves not worth working except in the zone of secondary enrichment; perhaps, strictly speaking, there is something to be said for this argument, but it certainly does not make for a clear understanding of the subject. If distinctions are to be drawn between the deposit itself and its more or less altered outcrop, confusion is bound to result. In fact, one of the great faults of the work lies in the author's failure to appreciate that in dealing with such phenomena as ore deposits, where a natural system of classification is practically impossible, broad lines must be followed; even so, there will be numerous border cases which every student of the subject will treat on somewhat different lines. One of the most striking points in the book, which well illustrates what has just been said, is the minute subdivision of mineral veins based upon differences, and sometimes small differences, in their mineral contents. In this Dr. Berg has followed Dr. Beck, the need for simplification apparently not having occurred to him. The whole of the treatment of mineral veins may be described as somewhat antiquated, seeing that over one-third of the work is devoted to fissure veins. This diffuse treatment is reminiscent of the days when the overwhelming proportion of all metallic minerals (with the exception of iron ores) was derived from fissure veins, as was the case a century ago. To-day, on the other hand, the output from veins is relatively unimportant, and the author does not seem to have realised how great the change has been in this respect.

The author divides his subject into the following main groups:

I. Magmatic segregations.
II. Contact deposits.
III. Mineral veins.

IV. Epigenetic ore bodies.
V. Sulphuretted ore deposits mainly of epigenetic origin.
VI. Ores formed by sedimentation.
VII. Gozzans.
VIII. Secondary (clastic) deposits.

Many of these groups are by no means satisfactory, inasmuch as the deposits included in them do not properly correspond to the titles given. Thus the author quotes as examples of magmatic segregation the magnetites in gneiss of the Lofoten Islands and the Kiruna ore, although he admits that the latter ore deposit is definitely younger than the adjoining eruptive rocks and accordingly not syngenetic with these. Similarly he includes among contact deposits, by which he understands those formed under the influence of contact metamorphism at or near the boundaries of the eruptive and the stratified rock masses, a number of deposits as to which he is bound to admit that he cannot ascribe their origin to any particular eruptive rock. He describes those as krypto-contact deposits, but obviously such a description is far from satisfactory. Among his epigenetic ore bodies he includes such deposits as those of Bingham and Bisbee, where the protore is undoubtedly syngenetic, gash veins and similar deposits in pre-existing cavities, true metasomatic deposits like the red hæmatites of Cumberland, and certain residual deposits, while his group of sulphuretted ore bodies is admittedly not a natural entity and contains examples of syngenetic, epigenetic, and indeterminate modes of origin. This method of dealing with the subject creates confusion rather than clearness; it is conglomeration, not classification.

There are various mistakes in geography, which should have been avoided; for example, the Sierra de Ronda is said to be on the Portuguese coast, and Leadville in England! Moreover, the work aims at describing every deposit of importance, but there are several notable omissions.

No doubt there is room for a good, small text-book on mineral deposits, but it will have to be on different lines from those of the present one; more care will have to be devoted to classification and to the discussion of the modes of formation of the deposits, and fewer examples, and those only typical ones, must be quoted, references to descriptions of others being generally sufficient. It is probably only in this way that the student can get a clear view of this complex subject. The work at present before us does not fulfil these conditions; it may be of use for reference to the experienced mining geologist who is not likely to be led astray by it, but it is scarcely a safe book to place in the hands of a beginner.

H. LOUIS.

The Living Soil.

Das Edaphon. Untersuchungen zur Ökologie der bodenbewohnenden Mikroorganismen. Von R. H. Francé. Zweite Auflage. Pp. 99. (Stuttgart: Franckh'sche Verlagsbuchhandlung, 1921.)

"EDAPHON" is the name which, from their analogy to the plankton, Dr. Francé has coined to cover all the forms of life occurring in the soil. In spite of the very considerable amount of work that has been done in recent years on these organisms, very little of it is at present available to the general biological reader. There are text-books of agricultural bacteriology and a considerable number of scattered papers dealing with single organisms or groups of organisms from the soil, but most of these reach only the specialist. Dr. Francé has therefore performed a real service in writing a brief general account of the soil fauna and flora, its conditions of life, and the influences of the different groups of organisms on one another and on the soil.

As a general handbook to the subject, however, it suffers from one considerable defect, for during the past few years great advances have been made both in this country and in America, of which apparently Dr. Francé has as yet heard nothing, since he gives no references to any non-German work of a later date than 1912. Even a casual glance through recent numbers of the English and American journals would not only have given him many useful facts, but would also have suggested methods of technique which would have made his own investigations much more fruitful. His accounts in particular of the insects and flagellates give very little idea of the number and variety of these creatures occurring in the soil.

The observations on the ecology of the organisms would also have been more satisfactory if a little more statistical information had been given. It is not very useful to be told that in May a cubic millimetre of soil contained 15 organisms (omitting bacteria), whereas in August the number had fallen to 3, unless we are also told how much variation there is between duplicate samples taken at the same time or at brief intervals. Since Dr. Francé frequently reminds us of the close analogy between the edaphon and the plankton, one naturally recalls the wide divergences found in duplicate catches of the latter. Probably he is right in believing that the figures given are significant, but the reader who wishes to understand what are the effects of temperature, moisture, season, and the physical and chemical properties of the soil on the organisms living in it, is at a great disadvantage if he is not told just what is the degree of significance.

In spite of these defects, however, the present

volume contains a great many useful observations and a very lucid and stimulating review of the subject. One may question whether the biological influences have quite the dominating importance in the soil that is here claimed for them, and in particular whether the organisms found in it can as yet be satisfactorily used as a criterion of the agricultural properties of a soil; but the subject is still young and its possibilities are undoubtedly great.

The Presentation of Thermodynamics.

Vorlesungen über Thermodynamik. Von Prof. Dr. Max Planck. Sechste Auflage. Pp. x + 292. (Berlin: W. De Gruyter und Co., 1921.)

ONE of the most universal generalisations that can be made about the study of mathematical physics is that everybody finds thermodynamics a very difficult subject. In consequence of this there have arisen several different ways of presenting it, which vary far more from one another than do the presentations in such subjects as dynamics or electricity. There is first the thermodynamics of the engineer, in which entropy is something steam has, which can be found from tables. Then there is the thermodynamics of the chemist, whose laboratory is stocked with semi-permeable membranes. He is a great designer of engines, but all his enjoyment of his wonderful instruments is spoiled by his perpetual suspicion that Nature is trying to score off him. Next, there is the thermodynamics of the mathematician; this scraps the chemist's machinery and does the whole business by means of Pfaffian forms, a peculiar branch of mathematics, and almost the only one in which it looks as if more comes out at the end than is put in at the beginning. Lastly, there is the super-man, who can see and count the atoms, who regards all the others as gamblers, though he is bound to admit that they know how to lay the odds. He occupies a position rather apart, being, so to speak, engaged in a study of the jurisprudence of thermodynamics.

Now (excepting the last), all these presentations claim to derive their results from the two laws of thermodynamics, but there is no agreed statement of those two laws. In most books the chapter on the Second Law is not opened by a formal statement of that law—as Newton's laws of motion would head the corresponding chapter in a book on dynamics—but it is necessary to have several pages of tendencious discussion first, to create the atmosphere in which the law shall be acceptable. This can only mean that the law as stated contains a good many implied assumptions. Some years ago Carathéodory, the pure mathematician, formulated the principles in a really logical manner, and it is to be hoped—if we can believe that the human mind is by taste rational—that this formulation will be more successful in making the subject easy than has the exceptional variety in presentation which has hitherto prevailed. Carathéodory's work was transcribed a year or two ago in the *Physikalische Zeitschrift* by Born. He insists that there is no way of shirking the Pfaffian problem in some form or other, but gives a simple geometrical description of it; in the consequent deduction of absolute temperature and entropy there is some rather heavy work which could probably be simplified. But the most important modification is the new place taken by temperature in the presentation. In the ordinary way it occurs muddled up with the Second Law, but here it is taken out and introduced as the primitive idea—of course, measured on an arbitrary scale. The consequence is that the First Law no longer deals with quantities which are undefined, and the Second Law becomes a clear-cut statement instead of a jumble of two statements.

The new presentation is too recent to have been adopted in text-books, and it will be most interesting to see whether it is destined to drive out the older types. The book under review is of a class about midway between those of the chemist and those of the mathematician. That it has gone through six editions shows that it is a first-rate introduction to the subject; but it certainly can be criticised from the logical point of view, for it brings in absolute temperature by means of the perfect gas, and only later justifies it in the general case. It is a philosophical question whether it is legitimate to introduce ideas connected with reality by means of a hypothetical substance—perhaps it may be defended, like the introduction of rigid bodies in dynamics. But the point really is that this method is apt to leave the student with the idea that absolute temperature is in some way connected with perfect gases, an idea rather encouraged by many of the examples that are usually cited. It is surely a pity to start by dealing with a special case, when the whole argument is that Carnot's cycle works exactly as well whatever the substance in the cylinder. Apart from this criticism, however, the whole work is an admirably detailed development of the theory, with numerous illustrative examples from physical chemistry. The chief changes in the new edition are in connexion with the theory of solutions; in particular, an account is given of the theory of J. C. Ghosh of Calcutta, of the freezing-points of strong solutions, which would seem to have attracted more attention in Germany than in this country. There is also more said about the equation of state of solids and their expansion coefficients.

We have dwelt perhaps with undue weight on the question of fundamentals, because this seems to us a matter which should be put right. But the present work, supplemented by a proper treatment of those fundamentals, certainly constitutes an excellent course in the general theory of thermodynamics.

Dialectic.

Studies in the Hegelian Dialectic. By Dr. John McT. E. McTaggart. Second edition. Pp. xvi + 255. (Cambridge: At the University Press, 1922.) 15*s.* net.

IT is curious that a book which professed only to be a study of Hegel, and deals with criticisms of the Hegelian method and principle current more than thirty years ago, should be reprinted to-day and present the same freshness and vigour to the reader now as it did then. This is the feeling with which one who read Dr. McTaggart's book on its first appearance now lays it down, having read it again from beginning to end. It contains the best exposition of the dialectic, and the best defence of the dialectic, and the best criticism of it by any living writer. The conclusion Dr. McTaggart reaches would be accepted probably even by the most convinced Hegelians, namely, the conclusion that the logic is of permanent value and the dialectic sound, but that the metaphysic is unsatisfactory and cannot be final. His own view would seem to be that the ultimate reality is a unity of personalities, but that this unity is not itself a personality. Most of this book was originally presented in papers read and discussed at the Aristotelian Society in the early 'nineties and published in *Mind*, for at that time the Society did not publish Proceedings. It is a living work to-day because, more than at any previous time, the problem of the methodology of science is in the forefront. Mathematical discoveries, which have caused a revolution in our mode of conceiving the physical universe, and the discoveries of the new psychology, which have profoundly changed our mode of conceiving the mind, have necessitated a reconsideration of what is implied in the experimental method. We have found a need for dialectic, for the logic of philosophy. The stone which was set at nought by the scientific builders of the nineteenth century is become the head of the corner.

In the thirty years which have elapsed since Dr. McTaggart's book was written there have been some notable attempts in philosophy to reform and advance the Hegelian dialectic. It would be interesting to know Dr. McTaggart's attitude towards them. In section 120 he seems almost to anticipate Croce's criticism of Hegel as failing to differentiate between "opposites" and "distincts." Also one would like to know how far he considers that Gentile, in the theory he has worked out of the identity of philosophy with its history, has met his objection to the place assigned by Hegel to philosophy in the supreme triad of absolute mind. Dr. McTaggart's own recent work, "The Nature of Existence," gives the impression that he has himself moved away from the position of these early studies and has fallen under the spell of the opposite method to that of the dialectic, the method which is known as logistic and has its home in his college. It may be, however, that he is illustrating in his own mental development the dialectical advance through negation. In any case we can say that this republication of his early work is of the greatest value to those who are endeavouring to follow the constructive work in which he is now engaged.

H. WILDON CARR.

The Methods of Ecological Investigation.

Geobotanische Untersuchungsmethoden. Von Prof. Dr. Eduard Rübel. Pp. xii + 290. (Berlin: Gebrüder Borntraeger, 1922.) 16*s.* 8*d.*

IT is now seventeen years since the first appearance of Prof. Clement's work on "Research Methods in Ecology," written at a time when this branch of knowledge was still in its infancy and its methods for the most part yet to be devised. Since 1905, however, considerable advances have been made, particularly in the two directions of intensive study of the habitat factors and the extensive study of the plant community.

The growth of the subject is indicated by the establishment, both in this country and in America, of specialised journals devoted to this field alone, and this growth has naturally been accompanied by the development of a definite technique for the study of plant societies. We therefore welcome the work before us, in which Prof. Rübel has aimed at giving us a survey of the present position of ecological methodology on the botanical side.

Broadly the subject matter falls into two sections corresponding to the two main lines of progress already mentioned. Of these the consideration of the factors of the habitat, climatic, edaphic, biotic and orographic, with the methods of their measurement, occupies nearly half the text.

The climatic section contains a useful account of several American types of atmometer, methods of measuring light intensity under water, etc. The section treating of edaphic factors is regrettably short, especially having regard to the extensive development in this direction. For example, details might usefully have been furnished of the freezing-point depression methods of estimating the concentration of soil solutions

and the more fundamental methods of chemical analysis. No description is given of a modern type of calcimeter such as that of Collin's, but only of the two Passon's calcimeters in which the sources of error still remain. Again, ecologists might reasonably hope to find in these pages an account of either the electrical or colorimetric methods for determining the hydrogen-ion concentration of soil solutions, or of the colorimetric determination of nitrates.

It is particularly in respect to physical and chemical methods, of which the details are often widely scattered in non-botanical literature, that the biological investigator needs most guidance. The elucidation of ecological problems is becoming every day more a question of the investigation of the chemical and physical properties of the environment as they affect the different species directly, and their relationships to one another.

The second part of the volume is devoted to a consideration of the plant community, and is a helpful summary of the recent work on the extensive side of the subject. Here are dealt with such aspects as frequency and the methods of its determination, the occurrence of "constants" and characteristic species, the life forms of plants as classified by Raunkaier, the chief plant formations and the important subject of cartography.

Prof. Rübel's considerable experience in the Swiss Survey lends especial value to his pertinent discussions of the various statistical methods. The results so obtained are often by no means free from the personal equation, and hence often have a spurious appearance of accuracy to which attention is rightly drawn. The classification of plant formations is, in essentials, that put forward by Brockman and Rübel in 1912, based largely on the physiognomy of the dominant species. The chief change is the creation of a new class termed Saxideserta for stony deserts in which cryptogamic vegetation predominates.

Ecology, from the very complexity of the problems with which it deals, must cull its methods from all branches of science, and if we have criticised omissions it is not without a due appreciation of the magnitude of the author's task and of the encyclopædic knowledge requisite to its ideal performance.

E. J. SALISBURY.

Avian Minstrelsy.

Songs of the Birds. By Prof. Walter Garstang. Pp. 101. (London: John Lane, The Bodley Head, Ltd., 1922). 6*s.* net.

IN his "Songs of the Birds" Prof. Garstang has given us an unusual but agreeable mixture of science and verse. His introductory essay on avian song is a contribution to the science of the subject which deserves serious consideration. His attempts to set down on paper representations of the songs of different species are also interesting, although opinions will probably differ as to whether he has greatly succeeded where others have failed. Finally, there are the author's own verses about the songsters, often incorporating his representations of their own music; but these, together with the little sketches from Mr. J. A. Shepherd's humorous pencil, scarcely fall within the scope of a notice in these pages.

Prof. Garstang starts from the assumption that "birds are not automatic musical boxes, but sound-lovers, who cultivate the pursuit of sound combinations as an art, as truly as we have cultivated our arts of a similarly æsthetic character. This art becomes to many of them a real object of life, no less real than the pursuit of food or the maintenance of a family." He also, following Warde Fowler, places bird song on the æsthetic level of the rude music of primitive man. The songs of birds, he tells us, "are in each generation an expression of the whole joy of life at its climax of achievement and well being," and he holds that it is wrong to regard them as essentially love lyrics. These views are a welcome reaction from the too mechanical conceptions that are common, but there is at the same time some danger of their leading towards too anthropomorphic ways of thinking.

Much ingenuity has been expended at various times, and with indifferent success, on the attempt to translate birds' songs into human speech or musical notation. Prof. Garstang obviously approaches this vexed question with a knowledge of music and a sense of poetry, and his endeavours to place the matter on a firmer footing are, at the least, interesting and instructive. As "the bird is a minstrel, not a musician," and as "*timbre* and resonance, rather than musical pitch, constitute the dominating features of a bird's sounds," the author has adopted a syllabic notation. His view is that "the secret of representation lies not in punctilious imitation of every sound (which is unattainable), but in accuracy of phrasing combined with a fair approximation to the succession of dominant vowels and consonants." As we have said, however, opinions are likely to differ as to whether the question is really solved, for the personal factor enters so largely into both the hearing of the songs themselves and the reading of the written symbols. The reader who has an ear may thus best judge for himself whether a useful advance in the means of studying and describing bird music has been achieved by such examples as the following representation of the song of the willow-warbler:

Sip, sip, sip, see! Tee, tew, wee, tew!
Witty, witty, wee-wee, weetew!

Our Bookshelf.

Columns: A Treatise on the Strength and Design of Compression Members. By Dr. E. H. Salmon. (Oxford Technical Publications.) Pp. xvi+279. (London: Henry Frowde and Hodder and Stoughton, 1921.) 31*s.* 6*d.* net.

THE question of the strength of columns is one of considerable difficulty, on both the theoretical and the experimental side, and the author is to be congratulated on the value of his contribution to this subject.

Dr. Salmon's book consists of three parts: Part 1 is a bibliography arranged chronologically and gives the author's name and the title of the work. Part 2 is an analytical discussion covering various methods of fixing the ends; in each case ideal conditions are first assumed, and then departures from these conditions are considered until the ordinary column is reached. Part 3, synthetical, contains accounts of various formulæ used in practice and the experimental evidence on which they are based. The last two parts are taken substantially from a thesis submitted for the D.Sc. (Engineering) degree of the University of London. Part 1 in the thesis was historical, consisting of short summaries of each important memoir, including experimental work; it is unfortunate that, owing to the present impossibility of publishing the complete work, this section has been compressed into a bibliography of sixteen pages. The treatment in Part 2 is mathematical without unnecessary refinements.

Apart from the advantage of the presentation in one volume of much valuable work, hitherto scattered in many books and journals, the author's systematic treatment has led him to elucidate various new points, and will undoubtedly stimulate the reader in the same direction. For the same reason the suggestions given for future research must carry weight. Dr. Salmon considers that the most pressing point for future research on columns is the question of the degree of imperfection common in practical direction-fixed ends. This matter is of great importance in other structural members as well as in columns, *e.g.* arch ribs and encastré beams. We can thoroughly recommend the volume to all who are interested in the subject of the strength of materials.

A Text-Book of Mineralogy: With an extended Treatise on Crystallography and Physical Mineralogy. By Prof. Edward S. Dana. Third edition, revised and enlarged by Prof. William E. Ford. Pp. ix+720. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1922.) 25*s.* net.

THIS well-known book was first published in the year 1877, and a second edition appeared in 1898. The present third edition leaves the form essentially unchanged, the close relation between the author's "System of Mineralogy" and this book having rendered it inadvisable to revise the chemical classification of the minerals until a new edition of that larger work can be undertaken. The distinguished author is now professor emeritus at Yale; he still retains the post of curator of Mineralogy, however, but being well advanced in years the revision of the book has been undertaken by Prof. Ford.

The principal changes appear to be the introduction of a section on stereographic and gnomonic projections, and improvements in the description and explanation of the optical properties of crystals. The reference to the very important recent work on the elucidation of crystal structure by means of X-rays, however, occupies only slightly more than one page, without a single illustration. On the other hand, however, there is a much longer and really valuable section on the determination of the refractive indices of microscopic crystals by the more recent improved microscopic methods of F. Becke and F. E. Wright.

We are glad to see that the references to classes of lower than full systematic symmetry as "hemihedral" and "tetartohedral" (possessing a half or a quarter of the full number of faces) is now only a passing one, as to an antiquated, misconceived, more or less discarded and inadequate method of description. The crystal classes are now referred to as possessing each their own definite elements of symmetry, the only truly scientific method of distinguishing them.

A. E. H. T.

General Economic Geology: A Text-book. By Prof. W. Harvey Emmons. Pp. xiii+516. (New York and London: McGraw-Hill Book Co., Inc., 1922.) 20*s.*

STUDENTS and others interested in economic geology will appreciate Prof. Emmons's volume. The scope of the work is extremely wide and all of the following are dealt with: coal, petroleum, natural gas, metalliferous and non-metalliferous minerals of economic importance, and building stones.

The text as a whole shows a great resemblance to that of two of the author's previous works, *e.g.* "Geology of Petroleum" and "Principles of Economic Geology," but the section on coal is entirely new. The chapter on oil appears to be a précis from the former of the two books mentioned, and some parts dealing with mineral deposits have largely the same text and diagrams of the corresponding earlier work. The chapters on the non-metallic minerals, however, have been greatly enlarged, and contain much additional information.

It is evident that the author has written his "General Economic Geology" primarily for an American public, since all his examples, where possible, are from American localities, with little or no mention of occurrences of equal or greater importance in other parts of the world. An outstanding example of this is the 70 pages which he devotes to the coalfields of North America to the exclusion of fields elsewhere.

The value of the book is greatly enhanced by the addition of an excellent bibliography, which will allow of a more specialised study of particular areas when required. Moreover, the text throughout is plentifully supplemented with maps, diagrams, and half-tone blocks.

Imperial Institute Handbooks. The Agricultural and Forest Products of British West Africa. By Gerald C. Dudgeon. Second edition. Pp. xii + 176 + plates. (London: J. Murray, 1922.) 7*s.* 6*d.* net.

SINCE the first edition of this handbook appeared in 1911 many changes have taken place. The development of British West Africa has experienced a serious

set-back through the occurrence of the war, but useful lessons have been learned and many subjects have come forward or called for increased attention. The cultivation of cotton has been shown to be successful and profitable in Nigeria, in the northern provinces great progress has been made in perfecting a cotton originally grown from "American Upland" seed, while the southern provinces have produced increasing quantities of an improved native cotton of the type of "Middling American." The products of the oil palm and especially the kernel of the nut have been in increased demand for edible purposes, but improved methods of extraction are still awaited, and the successful cultivation of the oil palm in the Dutch East Indies and British Malaya threatens to rival the industry in West Africa. Successful plantations of Para rubber have been established in Nigeria and in the Gold Coast, and the latter has become the chief cocoa producer of the world. The extension and improvement of the Agricultural Departments will be a factor in developing the possibilities of the various territories in West Africa for which Great Britain is now responsible. The handbook will serve as a guide to all who seek information on the agricultural and forest products of British West Africa.

Memoirs of the Geological Survey. Special Reports on the Mineral Resources of Great Britain. Vol. 2: Barytes and Witherite. By G. V. Wilson, T. Eastwood, R. W. Pocock, D. A. Wray, and T. Robertson. With contributions by H. G. Dines. Third edition. Pp. iv + 119 + 6 plates. (Southampton: Ordnance Survey Office; London: E. Stanford, Ltd., 1922.) 3*s.* net.

THE issue of a third edition of this memoir shows public appreciation of the economic work of the Geological Survey; the revision has involved further visits to all the principal mines, and the records of output include those of very recent years. A brief sketch of the characters of the two minerals concerned and of their uses precedes the detailed account of the mines. Photographs of crystals, and some account of the relation of barytes to metallic sulphides in the field, might have added interest to this section; but the cost of the memoir to the public has no doubt been carefully considered. The graphic tables showing the total output go back only to 1890. It would be of interest to trace the quick response of the Derbyshire miners to the demand that arose in 1856. The earliest date mentioned on p. 64 is 1892; but in 1857, two years after the industrial development of barytes lodes was started in the county of Cork, Derbyshire produced as much as 9000 tons. The thoroughness of the memoir as a record of present-day mining is shown by the descriptions of methods of treatment of the ore at various places, and of means of transport.

G. A. J. C.

The Edge of the Jungle. By William Beebe. Pp. 237. (London: H. F. and G. Witherby, 1922.) 12*s.* 6*d.* net.

MR. BEEBE has a graphic pen. His account of the life of bird, beast, and insect as seen from a small clearing on the edge of the British Guiana forest gives a vivid and kaleidoscopic impression of teeming life. His capacity for close and careful observation and his artistic power of selecting just the right details, combine to convey to the reader a feast of tropical colour, sound, and scent. It is impossible not to follow his account of, say, the happenings in the "army ants' home town" with an interest as tense as though he described the fortunes of human individuals. The transformation of "Guinevere" from a tadpole into a tree-frog holds the reader entranced. Mr. Beebe does not confine his attention entirely to his clearing; while on a visit to the gardens at Georgetown he was fortunate enough to see a group of manatees of which he records his impressions for the benefit of his readers. Incidentally he raises an interesting question as to the origin of flower growing for non-utilitarian purposes, which may suggest to the anthropologist a new field in which to view the influence of magic.

Land Drainage. By W. L. Powers and T. A. H. Teeter. Pp. ix + 290. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1922.) 13*s.* 6*d.* net.

LAND drainage occupies a large and important place in American agriculture, and the volume under notice is evidence of its prominence. It deals mainly with conditions in the Corn Belt and Western States, and is intended as a practical handbook from which may be obtained the most important details of procedure in the construction of drainage works. As these operations vary according to the nature of the land—reclaiming a marsh presents different problems from the draining of irrigated land which has begun to show signs of alkali—the authors have supplemented their general discussion by detailed descriptions of actual installations. These accounts include the balance-sheets of the operation, which show that in most of the schemes the increased crops have paid for the outlay in a short time. Particular interest attaches to the section dealing with drainage laws, and the manner in which the cost and the benefits of a proposed scheme for a district are divided among the farmers. The concluding chapter is devoted to the care and use of surveying implements, and a useful appendix of laboratory exercises is provided, in which the main principles of drainage are illustrated.

B. A. K.

Homework and Hobby Horses. Edited by H. Caldwell Cook. (Perse Playbooks, No. VI.) Pp. xii + 58. (London: B. T. Batsford, Ltd., n.d.) 3*s.* 6*d.* net.

THE Perse Playbooks are by now sufficiently well known to educationists. This little volume—the sixth of the series—embodies a selection of poems, ballads, and carols which have been produced, with one exception, by boys of the Perse School as a part of the system of the play-method of teaching English composition. The authors are all under fourteen, and the facility of the verse and, generally, its smoothness suggest that the statement that English verse composition has no terrors for, at any rate, some of the boys, is well founded. Some of the compositions are avowedly parodies, others are obviously derivative, but many show a poetic feeling which is surprising, as well as a considerable command of an appropriate vocabulary. The incongruous, the mark of the unpractised versifier, is commendably absent. It is interesting to note that of the various classes of poems, the carols are by far the most successful.

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 Cause of Rickets.

THE scientific interest of the work that has been done and is reviewed in the leading article in NATURE of July 29, p. 137, is that it shows that ultra-violet light, acting on the skin, produces by a photo-chemical reaction a definite substance which circulates in the blood. This substance is able to replace vitamin-A in the food; whether wholly or only partially is not yet certain, although it should not be difficult to decide the question. If the former, it appears that light actually causes the formation of the vitamin, as suggested by Prof. Harden, or at all events some compound closely similar to it. Dr. Rollier finds in his sunlight treatment of tuberculosis that cod-liver oil is quite unnecessary; but, of course, his patients get vitamin-A in butter and so on. In rickets, vitamin-A can apparently be reduced to a very small amount if there is plenty of sunlight, but it is uncertain whether the vitamin can completely replace sunlight.

Looking at the evidence as a whole, it seems to me that the six or seven causes enumerated in Dr. Findlay's article may really be reduced to two and perhaps ultimately to one. These two are deficiency of sunlight and of vitamin-A. Taking the remaining suggested causes in the order mentioned, it is obvious that bone cannot be made without its constituents calcium and phosphate, and, as the article points out, this is not a matter of great practical importance, especially if a proper quantity of milk is included in the diet. As to the avoiding of cereals in favour of meat, it seems that the question here is really one of the rate of growth. There is no doubt that the more rapid the growth, the more vitamin-A is needed, probably because it is stored to some extent in the new tissues, especially if these consist of much fat. Prof. Mellanby's experiments showed clearly that the addition of carbohydrate to the diet of his puppies necessitated more vitamin because the growth was so much more rapid than on meat diet alone. It is of interest that Dr. Rollier's experience with tuberculous cases is at variance with Dr. Findlay's with rickets. Rollier finds that much meat is injurious, and that oatmeal is one of the best foods. At the same time, he deprecates over-feeding.

The next cause, rapid growth, has been dealt with above.

I am inclined to think that the factors included in bodily confinement and lack of exercise actually mean lack of sunlight. I understand that at Johns Hopkins Hospital it was found that the two factors mentioned were immaterial if exposure to ultra-violet light was given. It is very doubtful whether massage and electrical treatment have much effect. It is remarkable that the effects ascribed to these are obtained by Rollier in cases which of necessity have to lie quiet, such as tuberculous vertebræ, by the action of sunlight alone. The firmness and "tone," even growth, of the muscles is very obvious.

I doubt whether much advance is likely to be made by obscure references to increase of general metabolism as an explanation of the action of ultra-violet light. The dogmatic statement that animal protein is of especial value rests on no good evidence. Apart from vitamin-A, diet does not seem of great importance, and even this vitamin may be reduced to a very small quantity in presence of adequate sunlight.

Should not "vitamin-B" in the seventh line from the bottom of the first column on p. 138 read "vitamin-A"? And also in the sixth line from the top of the second column?

I would conclude that we can reduce the effective factors in the prevention of rickets to vitamin-A and sunlight. It may be found to sunlight alone.

W. M. BAYLISS.

University College, London.

I AM much obliged to Sir William Bayliss for pointing out my inexcusable mistake of writing "B" for "A" vitamin. One of the advantages of solving the rickets question may be that we shall be able to use a more definitive and memorable nomenclature. "Anti-rachitic" factor is at present plainly inadmissible; it would be pleasant to call it "Hopkins' stuff," were it not obvious that the identity of the substances which promote growth and have a preventive influence on rickets is still an open question.

On the general question it seems to me that Sir William Bayliss is too ready to accept as a demonstrated fact that ultra-violet light, acting on the skin, produces by a photo-chemical reaction a substance which is equivalent to or identical with the factor in cod-liver oil which influences growth and rickets. It is a very tempting hypothesis because it brings into line a number of apparently discrepant observations. But it neglects a great mass of clinical experience which relates the occurrence of obvious rickets to the total intake of food and to the influence of exercise and massage. This experience may not be capable of the precise formulation one would like, it may not be of any very high order of observational or experimental accuracy, but it has, I think, none the less to be taken into account. It is known too, though here again the data are not beyond criticism, that light increases the rate of general metabolism in experimental animals.

The alternative hypothesis suggested in the article seems to have the advantage of bringing all the more or less certain and uncertain data which are available into line. What is, of course, needed is a whole series of clinical experiments made with the control and precision of the observations carried out by Dr. Harriette Chick and her colleagues in Vienna. Experiments of this kind are laborious and difficult. Meanwhile the practical sanitarian can get to work with sunlight and cod-liver oil and abolish the disease before any one has found out what part of the spectrum is effective.

THE WRITER OF THE ARTICLE.

The Phenomena and Conditions of Sex-change in the Oyster (*O. edulis*) and Crepidula.

IN NATURE of December 15, 1921 (vol. 108, p. 500), I described an experiment from which a sexually mature male oyster was obtained of a maximum age of 23 weeks, from the River Blackwater. In this experiment a fair number of oysters born in 1921 were obtained on specially prepared shells kept isolated *in the sea* with the view of determining the conditions of sex at a known age at later intervals. With the aid of a Government grant from the Royal Society it has been possible to follow up the experiment this year with the following highly interesting results. The young oysters this year were found mostly to be sexually mature or had recently spawned. In one sample of 32 examined from shells on the south shore, River Blackwater, most of the individuals were males, but one large individual (28 × 31 mm.)

was found on July 3 to be carrying thousands of young oyster embryos. This same individual was taken to Plymouth and kept alive; on July 18 it was again examined and found to be practically ready to spawn as a male.

It is, therefore, clear that even in England, in such suitable circumstances as occurred in 1921, oysters may become mature as females in the first year of growth, and further that a one-year-old oyster which had spawned as a female in the summer following that in which it was born changed immediately after spawning into a male. An examination of about 300 young oysters from the oyster-beds, estimated as one-year-old oysters from comparison with the known one-year-olds, gave the same result as that obtained from the examination of the spat known definitely to have settled in 1921, namely, that all the smaller ones were males but that some of the larger ones were either females or had already spawned as females and were changing or had changed into males. From these results the conclusion is drawn that all oysters are born as males, but may or may not change into females at an age of one year. The proofs for this statement are not yet sufficient to establish it as a fact, and indeed actual proof could only be obtained in the most fortuitous circumstances. The kind of result required to amount to proof would be one which gave 1000 individuals all males out of 1000 individuals examined, but as oyster larvæ settle at different intervals over a period of several months, a heterogeneous population with regard to age—apart from other causes—results unless very special precautions are taken. Since, however, sex-change may occur very rapidly, a difference in age of a few months in young oysters is sufficient to give time for sex-change in a collection of rapidly growing oysters whose greatest age is not more than one year, hence the difficulty. In spite of the difficulties, however, the knowledge of the conditions of sex-change mentioned above will help towards designing an experiment to lead to a definite result.

An extremely interesting result follows the observation that an oyster may function as a female at an age of one year, namely, that Gerbe's work in 1876 (*Revue et Magasin de Zoologie pur et applique*, 3 serie, iv.) can be regarded as confirmed. Gerbe examined 435 one-year-old oysters and found 35 with spawn in the gill, 127 with eggs in the gonad, 189 with sperm in the gonad, and presumably 84 with the gonad undifferentiated. An additional observation supporting these was also obtained from the Blackwater experiment mentioned above. A few Portuguese oysters (*O. angulata*) settled on the shells at the same time as the native oysters. By good fortune one ripe male and one ripe female were obtained. An artificial fertilisation made from these two individuals gave a very good proportion of swimming oyster larvæ and quite as good as a control gave on adult Portuguese oysters.

Thus Gerbe's results—although nearly 50 years old—may be accepted and taken into account definitely in discussions on sex in the European oyster. There is nothing in his results at variance with the observations described above. The view one naturally took of Gerbe's results—prior to the writer's observations given above—was that European oysters at birth developed in approximately equal numbers into males and females, and in view of sex-change afterwards taking place from female [1] to male and almost certainly also from male to female, the sex-phenomena in this species appeared to be unique. The rapidity of sex-change in oysters must now, however, be taken into consideration, and the writer's view of the sex-changes in the young oyster found to be carrying embryos this year may be recapitulated. That oyster settled some time in 1921 after June 9, it is predicated that this oyster became sexually mature as a male and spawned as a male in the summer of 1921 (see NATURE, December 15, 1921). On July 3 this year this same individual had spawned as a female and was carrying thousands of young, and on July 18 this same individual was again sexually mature and practically ready to spawn as a male. Thus this oyster has already had two and probably three experiences of sex alternating from male (?) to female and from female back to male within about one year. It is hoped to follow further sex-changes in this particular oyster, which is still alive, for its last condition of sex, namely as a male, was determined by tapping the gonad through a boring in the shell. It has been found that if the boring and tapping operations be carefully performed an oyster can easily and quickly recover and cement over the boring on the internal face of the shell.

The definite information obtained from this one oyster is corroborated by sex-conditions in other young oysters taken from the grounds whose age could be determined as one-year-old oysters with practical but not with absolute certainty. As indicated above, however, the conditions in 1921, namely the unusually long warm summer, were highly abnormal, and it is not to be expected that one-year-old female oysters will often occur in British waters.

The rapidity of the sex-change in oysters is paralleled by a similar observation on sex-change in the American slipper-limpet (*Crepidula fornicata*) in the same series of experiments in 1921–22. Crepidula, moreover, has undoubtedly a similar span of life to that of the European oyster. Sex-change from male to female occurred in *isolated* slipper-limpets (up to 26·5 mm. long) in the same period as that observed in the oyster, but unfortunately none of the sex-changed limpets were actually in spawn at the time of examination although the gonad in several cases was full of either ripe or fairly large ova, and the penis had been reduced to a mere discoloured trace. Individuals of a similar age settled on other slipper-limpets had the normal beautifully-shaped and well-developed healthy black penis of the young male. (See Orton, Proc. Roy. Soc., vol. 81, B, 1909, p. 469.)

The conditions under which sex-change occurs in the oyster and the slipper-limpet are of much general interest. In the oyster development of both the male and female sex-elements can occur in the winter and spring period. We also know that male-elements can begin and attain full development in the summer and autumn, but as yet we have no definite information about the development of the female sex-elements in the summer and autumn. Experiments have been started to obtain information on the latter problem, but until that information is obtained one is not in a position to discuss the possible causes of sex-change in the oyster. It would appear, however, that the factor for sex-causation is within the control of the organism and not in external conditions, but it will be more profitable to await further information on sex-phenomena before discussing the question fully. In Crepidula there is no doubt that sex-change occurs in young forms when the young males cannot function as males; on the other hand, if young males settle down on females, they undoubtedly remain males and function as such for a variable time, which may be as long as five or six years or as short as one year, but again the underlying factor appears to be that of opportunity to function as a male. The

[1] More than 100 cases of authenticated change from female to male have now been accumulated.

development of the male sexual elements in Crepidula is certainly independent of season, and so also apparently is that of the female sexual elements, since Crepidula breeds almost continuously from about March to December.

The males of Crepidula can certainly recognise females by some particular sense as yet unknown, as will be seen from the following facts. In examining a large number of chains of Crepidula (see Orton, 1909, *loc. cit.*), small to medium Crepidula were often found isolated and settled on the left-hand side of the females. Now this is the wrong side to permit of copulation, but in spite of the fact that copulation could not be effected these individuals were found to have an unusually fat and extensible penis capable of stretching probably twice as far as usual. In the experimental observations described above it was found that isolated Crepidula—certainly not older than those settled in the wrong place—had their penis absorbed. The conclusion is obviously reached that the males on the females knew that the latter were there and tried their best to reach them, whilst the totally isolated ones have resigned themselves unreservedly to a complete sex-change. It is only since proof has been obtained of rapid sex-change following complete isolation that a satisfactory explanation could be given for the phenomena of the misplaced males, but the explanation given above has for a long time been suspected of being the correct one. J. H. ORTON.

Marine Biological Laboratory, The Hoe,
Plymouth, July 25.

Wegener's Displacement Theory.

I QUITE agree with Mr. Lake's remarks (July 15, p. 77) as to the unsuitability of the tracing-paper method of investigating the merits of Wegener's hypothesis. All who wish to pursue the subject will do well to adopt his suggestions as to the practical method.

For some time I have been engaged on the subject, and, though I must plead guilty to the use of the tracing-paper method in the first instance—and there is this to be said in its defence, that we are attacking the master with his own weapon—results certainly warrant Mr. Lake's mild censure that for the truth of Wegener's theory to be accepted we must also believe in a great degree of plasticity for the earth's crust.

If the American coast be superimposed on that of Africa, the parts that coincide (according to Wegener, with a divergence of never more than 100 kilometres) are confined to that represented on the African coast by the distance from Kamerun to a point slightly north of the mouth of the Orange River. There is a divergence along the coast of Cape Colony, and an angle of approximately 15° between the superimposed coast of South America (N.E. coast of Brazil, etc.) and the African coast along the Gold Coast, Ivory Coast, Liberia, etc. These divergences may be easily accounted for by comparatively recent denudation, or fracture.

Assuming the truth of fracture—after Wegener—along the line Kamerun to Orange River, the Zwarte Bergen of Cape Colony certainly do fall into place exactly with the Permian cordillera of the Pampas. But this added coincidence merely leads us into greater difficulty. For to make the superimposed American coast coincide with the African coast in this manner, we have to swing the American continent through an angle of 45° from its present position.

This leaves us with Newfoundland in the position approximately 45 W., 32 N.—in the Atlantic Ocean.

The Hercynian Appalachians—another of Wegener's "test" ranges—appear in a position in the Atlantic north of Cayenne, stretching in a general N.N.E. direction (along the line 52 W., 8 N.—47 W., 20 N.). They are in the right direction for joining up with the British Hercynian range, but are separated therefrom by a distance of ocean above 2000 miles.

To lessen this distance, and bring it within a reasonable distance of the British Hercynian range for joining-up purposes, we cannot allow any bending of the American continent. Any alteration in the relative positions of North and South America throws the direction of the Appalachians out absolutely and entirely. The only way the joining-up can be done for both the Zwarte Bergen-Buenos Ayres range and the Hercynian range on both sides of the Atlantic is either (1) a great movement of the Eurasian continent south-west, or (2) a movement of the African continent south to a distance of about 500 miles from its present position, and at the same time a rotation about an axis somewhere in the neighbourhood of Suez (for example) of not less than 50°.

In other words, since the fracture, either the Eurasian continent has been rotated in a general S.E. direction (clockwise) or the African and Indian masses in a N.E. direction (counter-clockwise), or both these motions have taken place, from a centre somewhere in the Suez-Madeira Islands line.

Are the Himalayas, the Carpathians, the Alpine system, the Atlas Mountains, the result of the clashing together of the African-Indian, European-Asiatic continents by these movements? As Prof. Sollas has reminded me, the first word on Wegener's theory lies with the astronomers and physicists. To them I leave the task of finding a force which has acted in two parallel directions west on the North and South American continents, making their advance west without rotation relative to each other and overcoming the resistance at the expense of the Andes Cordillera and its continuation in North America, and has at the same time driven the Eurasian and Asiatic continents south-east and the African-Indian continent north-east (relative to the Americas) with such determination that the great folding of the Himalayas-Alps line resulted—and waited until Tertiary times to do most of it.

E. R. ROE-THOMPSON.

St. Edward's, Oxford.

The Elliptic Logarithmic Spiral.

I AM much obliged to Mr. Wright for his correction (NATURE, July 8, p. 40). I had made a search in English and Continental books on curves and concluded that this spiral had been overlooked as a curve. But it appears to have been recognised in connexion with the spherical pendulum. Prof. Lamb in his "Dynamics," p. 288, as I now find, refers to the curve as "a kind of elliptic spiral," and Dr. Besant describes it as "an ellipse gradually shrinking in size."

I take, however, a little unction in having given the curve a name, especially as it seems to be of importance in damped elastic systems with one degree of freedom, and in fact it may be called a characteristic. Thus in the elastic system without friction, the force displacement diagram is a straight line; with fluid friction varying as the velocity, we have the elliptic logarithmic spiral; and with solid friction, a series of parallelograms. The dissipation per cycle, its rate during the cycle, as well as what may be termed the timbre of the motion, are in this view brought out very clearly. H. S. ROWELL.

15 Bolton Road, W.4.

Pairing and Parthenogenesis in Saw-flies.

As the result of recent experimental studies in the biology of saw-flies of the family Tenthredinidæ, with particular reference to their parthenogenesis, I have been struck by the dearth of information as to their mating habits. My observations have revealed a novel point which I wish to record; and, in order to discuss its significance, I present first a brief summary of certain points relative to saw-fly breeding.

1. Females of *Athalia lineolata* Lep., on collecting, were found to be greatly outnumbered by the males; they paired frequently and probably were polyandrous. (The writer has a paper on this in the press.)

2. In certain species, *e.g. Pristiphora pallipes* Lep., the male is excessively rare.

3. In certain species, *e.g. Allantus* (*Emphytus*) *pallipes* Spin., no male has been taken or bred.

4. Some 30 species produce males only by parthenogenesis; some 13, females only by parthenogenesis; about 6 produce both sexes similarly. (See lists of Cameron and Enslin.)

5. A large number of species other than the above are facultatively parthenogenetic, and future work will greatly extend the list. (See work of Miss Chawner and the writer.)

6. Certain species, in captivity at any rate, refuse to pair. (See work of Fletcher, Miss Chawner, and the writer.)

7. Females of *Platycampus luridiventris* Fall., after persistently ignoring the males, may lay eggs parthenogenetically while kept with their food plant under a glass vessel and in the presence of the males. (Writer's observation.)

8. Virgin females of *Phymatocera aterrima* Kl., after laying eggs (which gave healthy larvæ) paired with males presented to them. Unfortunately the females were about spent before pairing and did not lay again.

9. A virgin female of *Nematinus luteus* Panz., after laying eggs which gave healthy larvæ, paired with a male and then, subsequently, laid other eggs. Unfortunately, through the wilting of the alder twigs, which I was compelled to use instead of young trees, I have been unable to rear the presumably fertilised eggs which were laid after the asexual batch. I cannot state, therefore, whether this female's parthenogenetic offspring are different in regard to sex ratio or in germinal constitution from the offspring of the batch produced after fertilisation. This I am hoping to elucidate later in this season by the use of other species.

Points 1-4 are fairly well known, but Nos. 5 and 6 are probably known only to the few workers who have studied the group, while Nos. 7, 8, and 9 result from my studies, and being new, so far as I am aware, they form the *raison d'etre* of this note.

These facts warrant the suggestion that in saw-flies the total sexual or partial sexual indifference of the sexes is a method for regulating (*a*) the numerical balance of the sexes and, *ipso facto*, (*b*) the amount of amphimixis necessary for the preservation of the species.

Again, the female saw-fly, by refusing or accepting fertilisation, or by first refusing the male, then laying asexually, next accepting fertilisation and, lastly, laying presumably fertilised eggs, achieves the same ends as the queen bee, which after fertilisation, produces females and workers from fertilised eggs, and males (drones) from unfertilised eggs. (This assumption, of course, rests upon the fact that the chromosome complement of the females and workers is twice that of the drones.)

The survival value of the parthenogenetic production of females and of both sexes in certain species is not difficult to apprehend, but the production of males only has presented a seemingly freakish and puzzling problem. The solution has been obscured by its being a laboratory observation, isolated, and uncorrelated with a knowledge of what occurs in nature or with such a fact as I have just presented. Doubtless males only may be produced in nature by certain females, but my observation suggests two further possibilities—that (1), in nature, certain females of a species may lay male-producing eggs and, subsequently, after fertilisation, eggs producing both sexes; (2) a certain number of females are set apart as virgins for producing males only, while others pair and produce both sexes. (There is too, of course, the remote possibility that fertilised eggs may yield only females sometimes.)

With such a range of possibilities for the production of the sexes the process of gametogenesis in saw-flies is likely to prove more complicated than has hitherto been supposed and may account for recent anomalous results.

Assistance in prosecuting the work has been rendered through a grant from the British Association.

A. D. PEACOCK.

Zoological Dept., Armstrong College
(University of Durham), Newcastle-on-Tyne.

Some Significant Relations in the Quantum Theory of Spectra.

THE non-radiating orbits of Bohr's atom are given by the relation

$$a_n = \frac{\tau_n^2 h^2}{4\pi^2 me\mathrm{E}}. \quad . \quad . \quad . \quad . \quad . \quad (1)$$

The frequency of the wave emitted in jumping from one orbit to another is given by the energy relation

$$h\nu_{n+m\to n} = \mathrm{A}_{n+m} - \mathrm{A}_n, \quad . \quad . \quad . \quad (2)$$

or

$$\nu_{n+m\to n} = \frac{2\pi^2 me^2\mathrm{E}^2}{h^3}\left(\frac{1}{\tau_n^2} - \frac{1}{\tau_{n+m}^2}\right). \quad . \quad . \quad (3)$$

The convergence frequencies, given by the values of m equal to infinity in (3), are given by

$$\nu_n = \frac{2\pi^2 me^2\mathrm{E}^2}{h^3\tau_n^2}, \quad . \quad . \quad . \quad . \quad (4)$$

and correspond to radiation emitted by an electron falling into the orbit a_n from rest at infinite distance. The frequency ν_n involves τ_n for only one orbit, and may be regarded as associated with that orbit.

Between (1) and (4) we have immediately

$$a_n\nu_n = \frac{e\mathrm{E}}{2h} = \text{constant}. \quad . \quad . \quad . \quad (5)$$

Or, the frequency associated with an orbit is inversely proportional to the radius of the orbit for the same kind of atom.

The average kinetic energy of a particle describing a S.H.M. of amplitude a_n and frequency ν_n (instead of the orbital frequency $n = 4\pi^2 me^2\mathrm{E}^2/\tau^3h^3$) is

$$m\pi^2 a_n^2\nu_n^2 = \frac{m\pi^2 e^2\mathrm{E}^2}{h^2} = \text{constant} \quad . \quad . \quad (6)$$

for the convergence frequencies of the same atom.

In his theory of chemical reaction and reactivity (Transactions of the Faraday Society, vol. xvii. Part 3, May 1922) Baly assumes (1) that an atom can gain or lose energy in terms of the elementary quantum of energy; (2) that the physical change, attending such gain or loss of energy, occupies a definite period of time which is the same for all atoms; (3) that the elementary quanta of all atoms are integral multiples of a fundamental unit which very probably is the elementary quantum of the hydrogen atom.

Equation (2) means physically that the energy difference $h\nu$ is transferred from the atom to the ether, where it resides as the energy of vibration of a shell of ether, the radius of the shell expanding with the velocity of light. Baly's second assumption gives us the thickness of this shell. If the time occupied in releasing the energy $h\nu = A_{n+m} - A_n$ be k seconds, the number of wave-lengths generated is $k\nu$. The thickness of the shell is therefore

$$k\nu\lambda = kc, \quad . \quad . \quad . \quad . \quad . \quad (7)$$

which is constant and independent of frequency.

Again, as the energy radiated is $h\nu$, and the number of pulses equal to $k\nu$, the energy radiated per period of vibration, or the energy in a shell of ether of the thickness of one wave-length, is equal to

$$\frac{h\nu}{k\nu} = \frac{h}{k} = \text{constant}. \quad . \quad . \quad . \quad . \quad (8)$$

It is interesting to note that Baly's third assumption, viz.

$$h \propto E, \quad . \quad . \quad . \quad . \quad . \quad . \quad (9)$$

makes the constants of equations (5) and (6) identical for all atoms. For similar identity of the constant of equation (8) it is necessary that, like h,

$$k \propto E. \quad . \quad . \quad . \quad . \quad . \quad . \quad (10)$$

SATYENDRA RAY.
University College, London, W.C.1,
July 12.

Extraction of Radiolaria from Oozes.

I HAVE recently obtained some deep-sea radiolarian ooze from which I am endeavouring to extract the shells with as little damage to them as possible. I have tried the method advocated by Mr. Martin J. Cole, in which disintegration is brought about by prolonged boiling with a strong solution of sodium carbonate, and also another method in which the deposit is boiled with a saturated solution of sodium acetate, cooled till crystallisation has taken place, and then warmed till the mass has melted and boiled again, repeating this process several times. Although the smaller shells are successfully extracted by this means, I come across many large fragments of beautiful silicious formation, evidently the result of the breaking up of larger and more delicate ones.

I wonder if any readers of NATURE could tell me of a better method of extraction, whereby I may obtain these larger ones entire? If so, I shall be extremely grateful. Evidently the above methods of extraction are too drastic for these more delicate forms.

H. L. THOMAS.
Dyffryn Vicarage, Neath, S. Wales,
July 10, 1922.

MR. THOMAS does not state whether his radiolarian oozes are recent or fossil. The two methods which he has employed are primarily intended for the disintegration of fossil earths such as the Barbados material, and as they depend for their efficiency on the disruptive action of crystallisation and the solvent action of alkalis on silica, they are necessarily more drastic in their action than is necessary for the cleaning of recent deposits.

Recent radiolarian deposits differ greatly in their nature, according to the rate of deposition and the depth. In some cases where the ooze has been rapidly formed it requires no further treatment than washing under a gentle stream of water on sieves of various grades. This method has the additional advantage of preserving the calcareous organisms, which are retained on the coarser sieves with the larger Radiolaria. The smaller forms pass through all sieves with the diatoms, etc., and may be separated from the muddy water by elutriation and decanting. If it is not desired to retain the calcareous forms the material may be treated with nitric acid. The general treatment may be found in Cross and Cole's "Modern Microscopy," pp. 257-261 (Bailliére, Tindall and Cox, 1922).

Some recent radiolarian oozes have come under my notice in which the rate of deposition has been so slow that the material is already in a subfossil condition, laminated in structure, and with the organisms more or less infiltrated with manganese. Such oozes are refractory; they contain scarcely any calcareous matter and so are resistant to acid treatment. They can be broken down only by repeated treatment with hot soda solution alternated with drying, and such methods are necessarily destructive to delicate organic structures like the larger forms of Radiolaria.

ARTHUR EARLAND.

An Attempt to Influence the Rate of Radioactive Disintegration by Use of Penetrating Radiation.

INVESTIGATIONS carried out by *Ellis* (Proc. Roy. Soc. 101, 1, 1922) at the Cavendish laboratory lead to the conclusion that quantum dynamics probably apply to the nucleus of the atom and lend support to the assumption that the emission of γ-rays from the nucleus precedes the disintegration process. This highly interesting hypothesis suggested an investigation whether the rate of radioactive disintegration can be influenced by exposing the substance to the action of penetrating radiation. Could the nucleus be induced to take up a γ-ray impulse supplied by an exterior source, it would mean a change in its stability and so most probably in the rate of its disintegration. As γ-ray source about 800 mg. radium element were used, and experiments carried out with uranium in radioactive equilibrium with UX and with radium D in equilibrium with radium E.

(*a*) *Experiments with Uranium.*—The thin-walled glass tube containing the radium preparation was placed for six weeks on a 2 mm. thick layer of uranium oxide of 1 cm.^{2} surface; by this arrangement practically all kinds of γ-rays emitted by the radium and all β-rays except the very soft ones reached the uranium preparation. By measuring the β-radiation of the uranium X in equilibrium with uranium before and after the experiment no change amounting to more than 0·1 per cent. in the activity could be detected.

Now, from the uranium quantity used, about 15,000 atoms break down in one second, so we can conclude from this negative result that the natural disintegration of our uranium preparation was certainly not followed by an artificial disintegration of more than 15 atoms per second. The radium preparation employed emits about 10^{11} γ-ray quanta in the time unit, about 0·1 of which was absorbed by the uranium atoms, so it follows that the absorption of $15/10^{10}$ of the emitted γ-impulses by the nuclei of the uranium atoms would have already been sufficient to produce a detectable change in the rate of the disintegration of the uranium.

(*b*) *Experiments with Radium D.*—1·2 g. radiolead chloride from Joachimsthal of 1 cm.^{2} surface was treated in the same way as the uranium oxide for 51 days. The β-activity due to RaE in equilibrium with RaD measured before and after the experiment showed no difference amounting to more than 0·2 per cent. Preliminary experiments with X-rays have similarly given a negative result.

G. HEVESY.
University, Copenhagen, July 11, 1922.

Black Coral.

By Prof. SYDNEY J. HICKSON, F.R.S., The University, Manchester.

IN a short article by Prof. J. Stanley Gardiner published in NATURE of December 15, 1921 (vol. 108, p. 505), attention was directed to the use of black coral by the natives of Java for making bracelets which are believed to act as a cure for rheumatism and to the widespread belief, "from Suez to the most distant parts of the Pacific," in the efficacy of certain magical powers of this substance. The use of black coral for this purpose is not only very widespread at the present day but has been prevalent also among both barbaric and civilised races from time immemorial. The ἀντιπαθές of the ancient Greeks was in all probability a kind of black coral, and was used as an antidote to the stings of scorpions and for other medical and magical purposes. According to some of the older writers the herb given by Mercury to Ulysses as a charm to protect him from Circe was a piece of Antipathes. Rumphius quotes Salmasius as having written in his notes on Solinus that Antipathes was used as a protection against sorcery. Pliny refers to it in his alphabetical list of stones. He says, Book XXXVII., Chapter 54, "Antipathes is black and not transparent: the mode of testing for it is by boiling it in milk, to which, if genuine, it imparts an odour (?) like that of myrrh." Dioscorides regarded Antipathes as a kind of black coral which was possessed of certain medical properties.

These and other references to the substance by ancient Greek and Roman authors do not, it is true, give us any certain clue as to the identity of their Antipathes, and it is only by indirect circumstantial evidence that the conclusion is arrived at that it was the axis of one of two or three kinds of marine flexible coral.

The definition of the word "corallium" as used in the time of Pliny may be derived from the comment he makes upon Gorgonia. "Gorgonia nihil aliud est quam curalium: nominis causa, quod in duritiam lapidis mutatur emollitum in mari; hanc fascinationibus resistere adfirmant."

There is no truth in the belief that corals are soft in the sea and become hard when exposed to the air, and we cannot, in modern times, accept the statement that they have the power of resisting fascinations; but it is reasonable to interpret this definition by Pliny to mean that to the Romans of his time coral was a marine substance with a soft cortex when fresh and that it was commonly believed to possess certain magical properties.

Pliny's milk test for Antipathes is interesting but unfortunately very obscure. The phrase he uses is "experimentum eius, ut coquatur in lacte: facit enim id murrae simile." But similar to myrrh in what respect? In odour, in colour, or in form? Solinus considers it to have been similar to myrrh in odour (Collect. v. 26), but other authors have interpreted Pliny to mean similar to myrrh in colour. I have recently applied this test to a piece of Antipathes in my possession and have found after prolonged boiling in milk there is a faint odour resembling that of heated myrrh, but the colour of neither the milk nor the coral seems to be in any way affected. For this reason I am inclined to believe, until my experiments on this subject are extended, that Pliny meant to say "similar in odour to myrrh."

Let us turn now to another fragmentary indication of the ancient use of black coral. The word "coral" is to be found in two texts of the English version of the Bible (Job xxviii. 18 and Ezekiel xxvii. 16). Prof. Peake has kindly informed me that Gesenius and other commentators consider that the Hebrew word "Ramoth" which is translated "coral" in the E.V. means "black coral," and that the word "Peninim" which is translated "rubies" in the E.V. really means "red coral." Thus Job xxviii. verse 18 should read: "No mention should be made of black coral or of pearls: for the price of wisdom is above red coral." I am not competent to form any definite opinion on the views of these commentators; but if they are right and black coral was known to the ancient Jews there may also be some explanation of a remarkable passage in the writings of Josephus.

In his book on the Antiquities of the Jews (i. 3. 6) Josephus relates that according to Berosus, the Chaldean, there is still some part of Noah's Ark in Armenia, and the natives carry off pieces of the bitumen (pitch?) from it to make into amulets for averting mischief. We have in this passage reference to a substance like bitumen (*i.e.* black and flexible when heated) which was made into bracelets and believed to possess magical properties. Of course, it may not have been black coral at all, but if black coral accompanied by the beliefs in its efficacy against evils of many kinds was transported to distant parts of the world, as we know red coral was transported at that period, it would not be remarkable if it became associated with the Noah's Ark myth. It would be a matter of great interest if scholars learned in Jewish antiquities could throw some further light on the use of either black or red coral by the children of Israel in early times.

The making of amulets from the pitch of Noah's Ark, and their use for averting mischief, brings us back to the statement in the article in NATURE mentioned above that the natives of Java make bracelets of black coral for curing rheumatism. The most complete account of this superstition in the Malay Archipelago is to be found in Rumphius's "Amboinsch Kruidboek" (xii. p. 195), published in 1750, in the article on *Corallium nigrum* or *Accarbaar itam*. Rumphius says that the natives make bracelets of it by soaking it in cocoa-nut oil and bending it into the form required over a slow fire while smearing it all the time with oil. It is then polished with a rough leaf. Sometimes it is inlaid with gold or silver ornaments. It is supposed to confer on the wearer all kinds of blessings (*zegeningen*) and to protect him from sorcery. It is sometimes made into sceptres for the chiefs and is also made into a powder by grinding with a stone, mixed with water and drunk as a medicine.

It would take too much space to give in detail the various diseases for which black coral was used as a remedy; but there is one point of difference between the account given by Rumphius of the use of the bracelets in his time and the account given by Mr. Pownall in his letter quoted in NATURE. Mr. Pownall says "the natives maintain that it must be used quite plain; and ornamentation of gold or silver renders them quite useless." Rumphius says that they ornament the inside of the bracelets with gold figures because they say, and "not without reason," that the coral must scratch the skin if it is to do any good. We may wonder if Rumphius smiled to himself when he wrote the words "niet zonder reden" in this sentence.

There were other kinds of Accarbaar or bastard corals which were known to the Malays in the time of Rumphius and used by them for medicinal purposes, but the *Accarbaar itam* or *Corallium nigrum* was regarded as the most important and was held in the highest esteem. Among these was the *Accarbaar puti*, which from the figure given by Rumphius was an Alcyonarian belonging to the family Isidæ and probably to the type genus Isis. This is of some special interest as the Mediterranean species of Isis was held in high esteem by the Mediterranean races in classical times, and was currently believed to represent the petrified hair of Isis. But that is another story, and one about which only the most fragmentary indications remain.

The task of identifying the various kinds of black coral mentioned by the ancient and later writers up to the end of the eighteenth century is extremely difficult, as detailed descriptions of the characters upon which the modern classification is based are almost entirely lacking. The substance was evidently black or brown in colour, it was capable of being bent or twisted when subjected to heat, and it was hard enough to be given a polished surface. Moreover, it may be presumed from various references that it was a product of the sea. It might have been, therefore, the Keratin axis of one of the Plexauridæ, of one of the Gorgonidæ or of one of the Antipatharia, or, finally, of *Gerardia savalia*.

The *Accarbaar itam* of Rumphius was probably a Plexaurid. The figure of the stript coral that Rumphius gives is not conclusive but quite consistent with this identification. In the description of the cœnenchym which covers the axis, when it is fresh, he uses the Dutch work Schorse, *i.e.* bark, whereas in the description of another Accarbaar which is almost certainly a Gorgonid he uses the word Korste, *i.e.* crust. In the description of a third Accarbaar which is obviously an Antipatharian he uses the word Slijm, *i.e.* slime. With such an accurate observer as Rumphius was, we may assume that the use of these different words for the cœnenchym signified a real difference in character between them. In the Plexauridæ the cœnenchym is relatively thick, in the Gorgonidæ it is almost invariably much thinner, whereas in the Antipatharia it is usually little more than a soft and delicate film covering the axis. This identification of the *Accarbaar itam* of Rumphius as a Plexaurid is consistent with Prof. Gardiner's identification of the bracelets obtained by Mr. Pownall in Java as the axis of Plexaura.

Rumphius states that the *Accarbaar itam* is not identical with Pliny's Antipathes because it does not give the smell or colour of myrrh on boiling in milk. For other reasons than this, however, we may feel certain that the Antipathes of Pliny and the earlier writers was not a Plexaurid. The evidence seems to point to the conclusion that the black coral commonly used by the ancients was the form mentioned by Imperato (1599) as Savaglia and now known to science as *Gerardia savalia*. (Until quite recently Gerardia was considered to be an Antipatharian, but it has now been definitely placed in the order Zoanthidea.) The reason for believing that it was Gerardia is that this coral grows in the Mediterranean Sea, whilst the Plexauridæ do not, that it attains to great dimensions (a great specimen in the British Museum being two metres in height and spreading fan-wise to a width of over two metres) and the surface of the branches is smooth and devoid of spines. It is possible that in addition to the Gerardia the main stem of some of the species of Antipatharia that are found in the Mediterranean Sea may also have been used. Gansius in his "Historia Coralliorum" (1666) describes a species, *Antipathes hirsutum*, found in the Sardinian seas which is in length greater than the human stature. The axis of such a specimen if polished would be difficult to distinguish from that of Gerardia.

The difficulty of determining the black coral of the ancients, however, is due to the possibility that they may have imported it from the South, in which case Plexaurid or Gorgonid coral may also have come into use. Thus Pliny says in writing on coral, Nat. Hist. xxxii. 11, "Gignitur et in Rubro quidem mari sed nigrius item in Persico—vocatur Jace—laudatissimum (*i.e.* red coral) in gallico sinu circa Stoechades insulas," etc. This passage indicates that the most valuable kind of coral known to the Romans came from the Îles D'Hyères and other places in the Mediterranean Sea, but a black kind was also imported from the Red Sea and the Persian Gulf, in which seas the *Corallium rubrum* is not found.

Black coral was also known to the Moors in early times, and was very probably obtained by the fishermen engaged in the famous red-coral fishery off Marsa-al-Kharaz, the modern Bona or Bône on the coast of Algeria. The Arabic name for black coral was "yasz" or "yusz," a word which seems to have some resemblance to Pliny's "jace."

These few notes on the use of black coral in early times may seem to be very fragmentary and inconclusive, but they may be, perhaps, sufficient to create some interest in and to stimulate further investigation in a chapter of zoological mythology which has not yet been written. It is probable that classical and oriental research will reveal a great many more references to this substance than are recorded in these notes, and it may be expected that the excavations of the antiquaries will bring to our collections some specimens of black coral that were used in ancient times; but I think there is sufficient evidence to prove that the belief in the magical properties of black coral is not only widespread at the present day but also carries with it the sanction of a tradition which has been transmitted from the early days of our Western civilisation.

The Determination of Stellar Distances.

By Dr. WILLIAM J. S. LOCKYER.

IN his presidential address delivered before the Royal Astronomical Society, in connexion with the celebration of that society's centenary (see NATURE, June 24, p. 815), Prof. Eddington referred to six great landmarks of astronomical progress during that century. He pointed out that this was a record of advance which was *continuous*, and not in great waves followed by periods of exhaustion. As he further remarked, the centre of most rapid progress has shifted from time to time and the various branches of astronomy have had their ups and downs. In this second category may perhaps be placed the determinations of the parallaxes or distances of the stars, because quite recently a very great impetus has been given to this branch of astronomy by the introduction of a rapid and effective new method.

So long ago as 1837 the first successful attempt to determine the parallax of a star was accomplished by Bessel, who made his result known in the last month of 1838, showing that 61 Cygni had a parallax of about one-third of a second of arc. Since that date this research has been carried on continuously and we have now catalogues of the parallaxes of a large number of stars. Among the observatories measuring trigonometrical parallaxes to-day, may be mentioned Allegheny, Dearborn, Greenwich, McCormick, Mount Wilson, Oxford (Radcliffe), Swarthmore, and Yerkes, and these institutions secure material which provides about three or four hundred parallaxes a year.

It is interesting to note that in the early days it was thought that the brightest stars were the nearest to us, and therefore attempts were first made to determine their distances. It was soon found, however, that estimates of distance based upon apparent magnitude were wholly futile, for the greater number of the larger parallaxes determined were of stars of the fifth, sixth, and fainter magnitudes.

The work of measuring the parallax of a star may be considered one of the most delicate operations in the whole field of practical astronomy. There are three methods available. The *absolute* method consists in making meridian observations at different times of the year and then studying the resulting places after all known corrections have been made. The *differential* method may be classed under two sub-heads. The first consists in measuring the position of the star to be studied in relation to neighbouring stars at different times of the year. If the neighbouring stars in the field of view of the telescope be close to the star under examination, a wire micrometer is used, but if distant, the heliometer is the more efficient instrument. The second differential method utilises the sensitive plate and consists in photographing a star region at different times and eventually measuring the positions of the star in question in relation to the neighbouring stars.

It was not until the year 1914 that the spectroscope was applied to the determination of stellar distances, and the method now in use is that originated and developed by Prof. W. S. Adams and other astronomers at the Mount Wilson Observatory in California. It is based on the fact that the intrinsic brightness of a star has an appreciable effect on its spectrum. Thus, if two stars have the same type of spectrum but differ greatly in luminosity they will probably differ greatly in size, density, and in depth of their surrounding gaseous atmospheres. If this be so, then their spectra should exhibit variations in the intensity and character of such lines as are peculiarly sensitive to the physical conditions of the gases in which they find their origin, in spite of the general correspondence between the two spectra. If, as Prof. Adams states, "such variations exist and a relationship can be derived between the intensities of these lines and the intrinsic brightness of the stars in which they occur, we have available a means of determining the absolute magnitudes [1] of stars, and hence their distances."

It has been found that certain lines in stellar spectra do give indications of variation with absolute magnitude,

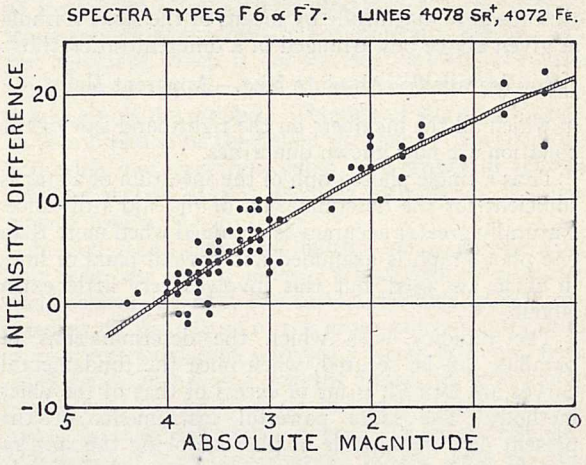

FIG. 1.

One of the fundamental curves formed from *known* parallaxes (black dots of stars of spectrum types F6 and F7.

When the intensity-difference in any star of these types has been determined, the absolute magnitude can be read off the curve and the parallax calculated.

and the detection of them we owe to Hertzsprung and Adams and Kohlschütter.

To determine the absolute magnitudes of stars any of three different sources of data can be utilised, namely, the trigonometrical parallaxes, parallactic motions, or proper motions. The most serviceable of these is the first, and reference to this alone will be made here.

The first step in the process is to have available a classification of star spectra based on detailed measurements of line intensities instead of on the more general eye estimations, estimations which have been extremely valuable up to the present time for the general classification of stars but are now superseded. Such a detailed classification for many of the brighter stars has been made and is being rapidly extended.

It is next necessary to construct a series of reduction curves for each type or class of spectrum or for small groups of types (see Fig. 1). These curves are based

[1] The absolute magnitude of a star is its apparent magnitude when reduced to unit distance. (Unit distance = Parallax of 0″·1.)

on the calculation of absolute magnitudes of stars as determined from the apparent magnitudes (which are known) and from the trigonometrical parallaxes (also known) obtained from one or other of the methods previously described. The equation for this computation is as follows :

Absolute Mag. = Apparent Mag. + 5 + 5 log (Parallax).

Stars of the same type of spectrum but of different absolute magnitudes are then compared with one another and the relative intensities of selected pairs of lines carefully measured. Curves are then drawn showing as ordinates the observed differences of intensities for each selected pair of lines, and as abscissæ the absolute magnitudes.

With these data it is a simple matter to determine the parallax of any star. Thus, it is only necessary to (1) determine first its type of spectrum, (2) measure the differences of intensities of certain lines in it and refer these values to the curves for that type ; the next step is to (3) note from the curve the corresponding absolute magnitude, and lastly (4) determine the parallax from this absolute magnitude by means of the same formula as given above but arranged in a different order, thus :

5 log (parallax) = Absolute Mag. − Apparent Mag. − 5,

in which all the members on the right-hand side of the equation are now known quantities.

Thus a single photograph of the spectrum of a star is sufficient for the determination of the star's distance. Naturally greater accuracy is obtained when more than one photograph is examined and several pairs of lines in them are used, but this involves very little extra labour.

The rapidity with which the determinations of parallax can be secured, when once the fundamental curves are formed, is far in excess of that of the older methods. The large powerful instruments of the present day are capable of photographing the spectra of very faint stars, so that a rapid survey of the whole heavens, at any rate to stars of about magnitude 6·5, will be accomplished in the near future.

At the recent meeting of the International Astronomical Union in Rome, great attention was paid to organising this work on an international basis. The Parallax Commission pointed out that there is a large amount of latent information regarding stellar distances in the long series of spectrograms obtained for other purposes at many observatories, and it is to be hoped that these data would be utilised.

A year ago the spectroscopic determinations of parallax were confined entirely to the United States at the Observatories of Mount Wilson and Harvard College. The Astrophysical Observatory at Victoria, B.C., now proposes to examine their slit spectrograms for this purpose.

In this country the only observatory occupied at present with this work is the Norman Lockyer Observatory at Sidmouth. For more than a year the large collection of spectrograms has been undergoing measurements in this connexion, and a large number of new photographs has been taken. An interesting point in this observatory's work is that the measurements of the intensity differences between pairs of lines are being determined by a method originated by the writer, which is different from either of those used at the American observatories. Thus an independent check on the American results is rendered possible.

It is necessary to point out, however, that this research on so large a scale could not have been undertaken had it not been for the opportune assistance rendered by the Department of Scientific and Industrial Research. This Department appointed Mr. W. B. Rimmer, D.I.C., in July 1921 as a research assistant, and his appointment was due to terminate towards the latter end of this year. It is with very great satisfaction that it may now be stated that it has been extended to September of next year. The work is so far advanced that now most of the fundamental curves are completed. It is hoped, therefore, to publish shortly the spectroscopic parallaxes of about 500 stars, followed after a short interval by another 500.

It is satisfactory, therefore, to record that in this new impetus given to the investigation of the distances of the stars, this country is taking a part, and it is hoped that other observatories here which have useful material will join in and discuss it from this point of view.

This line of research should also provide an interesting field of work for the amateur astronomer. The instrumental equipment required need be only on a moderate scale, for a five-inch telescope, fitted with a suitable prism, would meet the case, if a larger one were not available. It is a definite and straightforward piece of research which would be a valuable contribution to astronomy.

Short-wave Directional Wireless Telegraph.[1]

By C. S. FRANKLIN.

DIRECTIONAL wireless telegraphy is by no means a new development, for Hertz made use of reflectors at the transmitting as well as the receiving ends in order to augment the effects, and to prove that the electric waves which he had discovered obeyed, to a considerable degree, the ordinary optical laws of reflection. Senatore Marconi, in his earliest endeavours to develop a telegraph system using electric waves, also employed reflectors to increase the range and get directional working.

The discovery by Marconi of the great increase of range obtained by the use of longer waves, and the earthed vertical aerial, practically stopped development on directional lines for the time being. The demand of the time was for increased ranges ; and as the first practical application of wireless telegraphy, namely, working to and between ships, required "all round" working, there was very little call for directional systems.

To-day the range has arrived at the maximum possible on the earth, and the wave-length has increased to such an extent that the frequencies pro-

[1] From a paper read before the Institution of Electrical Engineers on May 3.

posed are within or near to the limits of audibility. The possible gamut of wave-lengths is becoming very fully occupied, and although the development, during the last four years, of nearly pure continuous-wave transmitters, and of receivers with vastly improved selective powers has eased the problem, the time will soon arrive when the only way of increasing the number of possible services will be by employing systems having good directional characteristics.

There are, broadly, two general classes of directional aerial systems: (*a*) Those having the general characteristic that their directional power or polar curves are nearly independent of their dimensions. The directional result is obtained by opposing the effects of a number of aerials, or parts of an aerial with suitable phasing adjustments, the degree of opposition being a function of the direction. Systems of this class may be made small compared with the wave-length employed; for the purposes of position finding, and as receiving systems enabling interference to be eliminated from several directions, they have already been developed to a considerable degree. The simplest example of this class is the well-known frame aerial. (*b*) Those having the general characteristic that their directional power or polar curves depend on their dimensions relative to the wave-length employed. In this class the directional result is obtained by adding the effect of a number of aerials, or parts of an aerial, when working in the required direction. The underlying principle is that the effects, for the required direction, are integrated over a wide front in proportion to the wave-length. Such systems can, therefore, have small dimensions only when using short waves, and this fact makes their development difficult.

As examples of such systems may be mentioned—

(1) Reflector systems in general.

(2) Systems composed of lines of aerials, at right angles to the working direction, correctly adjusted as regards phase.

(3) The Beverage long, horizontal receiving aerials.

The reflector system was the first tried for wireless telegraphy. The use of reflectors of reasonable dimensions, however, implies very short waves of the order of a few metres, and the very high attenuation of such waves over land or sea, and the difficulty of getting much power into them, tended to make early attempts very discouraging.

The investigation was commenced by Senatore Marconi in Italy in 1916, with the idea of developing the use of very short waves, combined with reflectors, for certain war purposes.

The waves used were 2 metres and 3 metres. The only interference experienced with such waves is from motor boats and motor cars, for these machines apparently emit waves from near 0 up to about 40 metres in length. A coupled-circuit spark transmitter was developed, the primary having an air condenser and spark in compressed air. By this means a moderate amount of energy was obtained, and the small spark-gap in compressed air proved to have very low resistance. The decrement of the waves emitted was judged to be of the order of 0·03. The receiver used was a carefully picked crystal, while the reflectors employed were made of a number of strips or wires tuned to the wave, arranged on a cylindrical parabola with the aerial at the focus. The transmitting system was arranged so that it could be revolved and the effects studied at the receiver.

Reflectors having apertures up to $3\frac{1}{2}$ wave-lengths were tested, and the measured polar curves agreed very well indeed with the theoretical curves. The use of two reflectors with apertures of $3\frac{1}{2}$ wave-lengths, one at the transmitter and one at the receiver, increased the working range about 3 times.

These Italian experiments showed that good directional working could be obtained with reflectors properly proportioned with respect to the wave-length. The attenuation over sea for the wave-length used was found to be very high, and with the apparatus available the maximum range obtained was 6 miles.

The experiments were continued at Carnarvon in 1917. With an improved compressed-air spark transmitter, a 3-metre wave and a reflector having an aperture of 2 wave-lengths, and a height of 1·5 wave-lengths, a range of over 20 miles was obtained to a receiver without a receiving reflector. The experiments at Carnarvon brought into prominence a property of wave propagation which is not generally known, and the extent of which is not realised, namely, the very rapid increase in the strength of the electric field with height above the ground. The rate of increase appears to be a function of the height divided by wave-length, and while not very noticeable with waves of several hundred metres, is very marked with waves of a few metres' length.

It was found that the limiting range at sea level and over sea was 4 miles. When both transmitter and receiver are at a low level the range is very dependent on the nature of the intervening country, and is very restricted even over sea; when, however, both stations are many wave-lengths above the intervening country its nature is of far less importance, and the range is increased many times. These experiments showed that very considerable ranges were possible with very short waves.

In 1919 experiments were commenced at Carnarvon with valve transmitters, with the idea of producing a directional telephone system. A wave of 15 metres was selected, which while well within the capacity of the power valves available, allowed a simple reflector to be used without too large a structure. After some trials a single valve transmitter was arrived at taking about 200 watts with a 15-metre wave, and giving 1 ampere in the centre of a half-wave aerial. A heterodyne receiver with supersonic beat-note was employed. Finally, very strong speech was obtained at Holyhead, 20 miles away. The strength was such that shadows produced by small hills and buildings were scarcely noticeable unless the stations were close behind them.

The next point was to test the maximum range, and particularly to find whether such waves would carry over the horizon, and whether there would then be a rapid falling off of strength. Tests were carried out with the Dublin Steam Packet Company's boats running from Kingston to Dublin in June 1920, and speech was received in Kingstown Harbour, 70 nautical miles from Carnarvon, and the point was proved that there

was no rapid diminution of strength after passing the horizon line from Carnarvon.

The range of the system was also tested wholly over land. A site was chosen at Hendon, and a reflector and transmitter for 15-metre waves erected with the reflector pointing towards Birmingham. Tests were commenced in February 1921 from Hendon to a portable receiver on a motor car. Very good speech was received up to 66 miles, and fair speech in the neighbourhood of Birmingham. A reflector station was then erected at Frankley near Birmingham, 97 miles from Hendon, and tests were started there in August 1921.

Measurements with and without the reflectors indicate that the energy received when both reflectors are up is about 200 times the energy received when not using the reflectors. Local measurements of the polar curves taken round the station show that the electric field in front of the station is increased approximately 4 times by the use of the reflector, and that the same order of increase is obtained during reception; the increase of energy received due to the use of the two reflectors should therefore be $4^2 \times 4^2 = 256$ times.

During the continuous-wave tests at Carnarvon it was found that reception was quite possible on the transmitting aerial while the transmitter was operating. The heterodyne may be either the transmitter, or an independent small heterodyne in the receiver. Both the transmission and the reception utilise the same aerial and reflector, and the transmitter is left going and can be operated while receiving.

There is no reduction in strength while the transmitter is on, but a practical trouble has appeared. Owing to the comparatively large power, strong currents are induced in all conducting structures and circuits close to the reflector and transmitter, such as the supporting towers and buildings, and every variable contact produces a noise. The elimination of all variable contacts in the neighbourhood of the transmitter has proved a work of some magnitude.

Reflectors besides giving directional working, and economising power, are showing another unexpected advantage, which is probably common to all sharply directional systems. It has been noted that practically no distortion of speech occurs, such as is sometimes found with non-directional transmitters and receivers.

Although the results between Hendon and Birmingham constitute a record for telephony for ratio of range to wave-length—for such results were believed to be impossible two years ago—they are only a first attempt and do not represent the best that can now be done after the experience gained. But it has been demonstrated that wave-lengths of the order of 20 metres are capable of providing point-to-point directional commercial service over very considerable ranges. Such services will be comparatively secret as compared with the usual non-directional type of transmission.

The directional effect obtained with reflectors which are large compared with the wave-length is so good that it was suggested that it would prove very useful for position finding for ships near dangerous points.

The general idea is that a transmitter and reflector revolving will act as a kind of wireless lighthouse. It is not intended at present for long ranges, but rather that revolving reflectors should be erected in position, similar to those at present occupied by fog signals, and be capable of similar ranges, so as to give the position to ships during fog when within about 10 miles of the danger point.

An experimental revolving reflector was erected on Inchkeith, and tests were made to s.s. *Pharos*, the lighthouse tender of the Northern Lights Commissioners during the autumn of 1920. With a 4-metre wave, spark transmitter, a reflector of 8 metres' aperture, and a single valve receiver on the ship, a working range of 7 nautical miles was obtained. The reflector made a complete revolution once every 2 minutes, and a distinctive signal was sent every half-point of the compass. The bearing of the transmitter could then be determined within ¼ point of the compass, or within 2·8 degrees.

The best method of giving the direction to a ship by means of such a revolving beam requires consideration. When listening in a receiver to a moderately sharp revolving beam the signals are heard only for a very short time. The exact time of maximum signals is not easy to determine by ear, but the times of starting and vanishing are easy to determine, as the rate of rise and fall of the signals is extremely rapid. The time half-way between these two times gives with great exactness the moment when the beam is pointing to the ship.

It would be quite possible to arrange to send a general broadcast signal when the beam passes through true north; then by arranging for the beam to revolve at a perfectly uniform rate, the bearing on the ship could easily be determined by means of a stop-watch. This method is probably the most accurate, but has some disadvantages. It entails accurate timing mechanism at the transmitter, the use of two waves, and three, or perhaps four receivers on the ship, as well as the use of a stop-watch.

For the short wave two receivers are required, one at each end of the bridge, or one fore and one aft. This is necessary to avoid screening by the ship itself. If the broadcast wave for giving the time when the beam passes true north is another short wave, then two more receivers would be required.

The method provisionally adopted avoids accurate timing mechanism at the transmitter and the use of a broadcast wave. On the base of the revolving reflector contact-segments are arranged so that a definite signal is transmitted every half- or quarter-point of the compass.

The apparatus proposed is of a very sturdy nature. The spark transmitters are robust, and last for years without attention. The receivers are simple valve rectifiers with fixed adjustments except for a "backing off" potentiometer for dealing with powerful signals at close range. The attenuation of these waves over sea is so strong that a little experience enables distance to be judged by strength of signals, and this can be measured by means of the potentiometer. The only qualification necessary for a person determining the bearing is the ability to read a few Morse signs.

The success of the present experiments indicates a wide sphere of usefulness for the new short-wave directional wireless system.

Obituary.

PROF. W. WISLICENUS.

BY the death, on May 8, of Wilhelm Wislicenus, professor of chemistry at the University of Tübingen, organic chemistry lost one of its most fruitful research workers, who contributed in no small measure towards placing the science on the basis which it now occupies. He was born at Zürich on January 23, 1861, and was the eldest son of Johannes Wislicenus, that great organic chemist whose name stands on the roll of fame co-equal with those of Hofmann and Frankland. At the time of Wilhelm's birth his father, who had, in the previous year, moved from Halle to Zürich, where he had married Katherine Sattler, the granddaughter of Wilhelm Sattler, joint discoverer of "Schweinfurt green," held the chair of chemistry and mineralogy under the council of the Canton at the School of Industries. Wilhelm may be said, therefore, to have inherited his chemical genius both on his father's and mother's sides.

W. Wislicenus received his early scientific training at the University of Wurzburg, to which his father had moved, in succession to Adolf Strecker, in 1872, and it was from here that he published his first paper, "On a New Reaction between Potassium Cyanide and Phthalide," a reaction which he was able to prove to be of general application, and which he applied to a number of other lactones with fruitful results. In 1885 his father succeeded Kolbe at Leipzig, but Wilhelm continued to work at Wurzburg, and thereafter, until 1903, he published a series of important communications from these laboratories. In this year he removed to Tübingen, where he continued to work until shortly before his death.

The earlier work of Wilhelm Wislicenus is intimately associated with the behaviour of metallic sodium towards organic esters, a problem towards which the attention of many chemists of his time was directed, and in connexion with which his father had already published his epoch-making paper, dealing with ethyl acetoacetate and its application as a synthetic agent, in the "Annalen" of 1877. Indeed, we are told by W. H. Perkin in his Johannes Wislicenus memorial lecture that the laboratory at Wurzburg was, during the early 'eighties of the last century, busily engaged in carrying out syntheses by the aid of ethyl acetoacetate and ethyl malonate. It is not surprising, therefore, that the young Wislicenus should have followed the general trend, and that one of his earliest papers, published from Wurzburg in 1886, should have dealt with the interaction of metallic sodium on a mixture of ethyl acetate and ethyl oxalate, as an outcome of which he was able to discover ethyl oxalylacetic ester. Wislicenus at once realised the importance of this discovery, and he was able later, both by himself and in association with his co-workers, to apply the new reaction to the preparation of a large number of α-ketonic esters, and, indeed, our knowledge of these important substances is mainly due to him.

About this time, also, the general question of the movement of a hydrogen atom from carbon to oxygen, as illustrated by the behaviour of ethyl acetoacetate, and the co-ordination of this phenomenon with others, notably that exhibited by hydrocyanic acid, was receiving considerable attention, and, in 1885, C. Laar published his famous hypothesis in which he coined the word "tautomerism." Laar imagined oscillatory conditions within the molecule which caused the hydrogen atom to take up one or other position alternately. He therefore presupposed the simultaneous existence of both modifications, or, in other words, he considered that the phenomenon was intra-molecular and not inter-molecular. Even at the present time this problem is by no means solved, and it cannot yet be said that Laar was not right in regarding the basis of change as intra-molecular. Still, there is no doubt that, in one of its aspects, the Laar hypothesis did not provide for the existence of the tautomeric individuals, and it was, initially, due to W. Wislicenus that, in this restricted sense, the hypothesis was shown to be wrong. The discovery of the existence of two forms of ethyl formylphenylacetate was made by W. Wislicenus in 1887, during his experiments on the action of sodium on mixtures of organic esters. Earlier in the year Piutti had shown that when a mixture of ethyl acetate and ethyl formate was used in this reaction the expected ethyl formylacetate was not produced, or if produced, at once underwent inter-molecular condensation yielding the aromatic compound trimesic ester. In order to avoid this, Wislicenus replaced the ethyl acetate by ethyl phenyl acetate and obtained the open chain formyl esters. He showed that the two esters he isolated were distinct substances, one a liquid giving pronounced enol reactions, the other a solid which possessed the characteristic properties of the keto modification. Since that time many examples of the same kind have been recorded, several of which have been discovered by Wislicenus and his pupils. The whole question is summarised in a lecture given by him at Leipzig in 1897, embodied later (1898) in one of the Ahrens' Sammlungen, in which he clearly enunciates his view that tautomeric phenomena are reversible isomeric changes. Prior to this, in a paper published in the *Berichte* for 1895, the following passage occurred: "Über die Natur der Isomerie ist eine Entscheidung wohl erst nach ausführlicheren Untersuchungen zu treffen, wenn es mir auch am wahrscheinlichsten zu sein scheint, dass hier die bei den Aldehyden, Ketonen, und β-Ketonsaurenestern vermisste tautomeren Formen vorliegen"; a view which was to receive full verification in the later work of Kurt Meyer and Knorr.

Wislicenus continued to work on the general question of tautomeric change for many years after this, and in 1912 he published a further paper in the *Annalen* dealing with the chemistry of ethyl formylphenylacetate. By that time four isomeric modifications had entered the field, but, in the paper quoted, he strongly expresses his view that only two of these, namely, the liquid α-form (enol) and the solid γ-form (M.P. 100°, enol-aldo), are chemical individuals. The β-form (M.P. 70°) and Michael's modification (M.P. 50°) he regards as mixtures of the α- and γ-forms. In 1916, in a paper also published in the *Annalen*, he describes the two forms of the methyl ester of phenyl-

formylacetic acid, both of which are solid, and discusses the curious property of the β-form of combining with methyl alcohol.

It was not, however, in this field only that the experimental skill and keen insight of Wislicenus found scope. His activities in other branches of the science, too numerous to mention in a short monograph such as this, find expression in upwards of one hundred communications, published chiefly in the *Annalen* and in the *Berichte*. Nevertheless, some of these cannot be passed over without comment. For example, in 1892 he discovered a new and simple method for the preparation of hydrazoic acid by causing ammonia and nitrous oxide to react in the presence of sodium. Later, in 1905, in conjunction with Otto Dimroth, he utilised the sodium azide thus formed for the preparation of the simplest organic azide, methylazide (CH_3N_3), by causing it to react with methyl sulphate.

One of the most frequently occurring phenomena met with during the course of organic chemical reactions is that which involves the movement of groups, such as the hydrocarbon radicals, from one element to another, a change which appears to be closely related to that which is associated with the movement of a hydrogen atom within a tautomeric system. Numerous well-known reactions, such as, for example, the Hofmann synthesis of primary amines, the Beckmann rearrangement, and so forth, involve a transference of this kind, and it is, therefore, of interest to note that Wislicenus was able to discover certain typical examples of the migration of an alkyl group from oxygen to nitrogen, and to study the conditions under which the change occurred. Thus, in 1900, he showed, in conjunction with M. Goldschmidt, that phenylformiminoethyl ether, OEt.CH=NPh, is converted, to the extent of about 40 per cent., into the isomeric methylformanilide, when it is heated at 230-240°. Later he was able to prove that the C-methyl ether of caffeine is readily converted into the N-methyl derivative.

Wilhelm Wislicenus was the distinguished son of a distinguished father. His name will always occupy a foremost place in the front rank of the organic chemists of his time. J. F. T.

Dr. A. G. Mayor.

The death of Alfred Goldsborough Mayor, at the comparatively early age of fifty-four, deprives the scientific world of a worker whose experience in tropical marine biology was unrivalled. Mayor stood in the direct historical succession of American participation in this field, for as the mantle of Louis Agassiz fell on his son Alexander, so did Alexander's mantle fall on the shoulders of Alfred Mayor, who accompanied him as assistant on many of his wanderings in the Pacific. When, in 1904, Mayor was appointed director of the Marine Biological Department of the newly founded Carnegie Institution of Washington, he really entered into his inheritance, and though so many of the projects of his fruitful brain will never mature, the work which has been accomplished at his laboratory in the Tortugas, Florida, and during many expeditions, forms his imperishable monument.

This laboratory, where Mayor died on June 24, is situated at the southernmost point of the United States, 70 miles west of Key West, on a tiny island (Loggerhead Key) which is surrounded by the purest ocean water. It was selected for this especial reason, for Mayor felt that nowhere else in Florida could the proper conditions for the experimental investigation of marine animals be secured. The position is not without disadvantage, and it is generally considered advisable to close down for the autumn hurricane season and for the winter, during which Mayor carried out his expeditions to other seas and islands. The Tortugas Laboratory was generally only available between early May and the end of July. This, however, is the most suitable time for the university research workers of the United States, from whom Mayor drew his investigators by personal invitation. These invitations, to work free of all expense and with payment of travelling expenses, were freely issued to all those whom he felt had some problem which could be favourably attacked at the Tortugas, and until that problem was, as nearly as possible, solved, no pressure embarrassed the research, but season after season it was his custom to reinvite those who had studied with him before and put in their way opportunities which he felt they might have missed before.

The success of his policy is to be seen in the splendid list of researches which stands to the credit of the Tortugas Laboratory. His own publications range widely over systematic zoology ("The Medusæ of the World," published in 1911), comparative physiology (especially the series of studies on the jelly-fish Cassiopea), the physicochemical properties of oceanic water, and biological problems like the growth rate of corals, and reflect his many-sided personality and his abounding energy. The work of his colleagues in whatever subject shows his direct interest and influence and the pains which he took to provide the most complete and satisfactory equipment. Whatever novel line of investigation was likely to throw light on marine work was certain of his most enthusiastic co-operation, and in this connexion may be mentioned the encouragement given to workers on the bacteriology of sea-water, like Harold Drew and Lipman, and the development of scientific under-water photography by W. H. Longley.

The expeditions which Mayor organised and carried out are too numerous to mention, but those to Murray Island, on the Great Barrier Reef, in 1913, and to Tutuila, in American Samoa, in 1915–20, really broke fresh ground in the investigation of tropical marine faunas. At both places he made an intensive study of the coral reefs and was able to demonstrate certain very interesting relations between the physiological characteristics of the different reef corals and their position and development on the reef. These and many other problems of importance were attacked by Mayor and his co-workers, but all the results are not yet published.

Mayor was as faithful in friendship as he was fascinating as a companion. The energy and vitality of his body and mind, his dramatic sense, the tenacity of his memories of men and countries, the range and grasp of his knowledge, all never failed to rouse the admiration of his friends. Something has been said of the zeal with which he furthered the efforts of those who worked with him. It could even be stated that

he endangered the success of his own researches by the readiness of the aid he rendered to others.

Mayor cherished a great ambition to remove the equipment of the Tortugas Laboratory to some locality in the West Indies and make it a truly international meeting-place for biologists. Just before the war his opportunity seemed to have come, and he was about to enter into negotiations for a site in Jamaica when the storm broke. It was a bitter disappointment to Mayor that he was not able to proceed with his project after the war, not least because he hoped that, in his yearly assemblies, English biologists would be represented more fully than in the past, and that in this way the cause of Anglo-American unity, which he held very dear, would be furthered. F. A. P.

DR. ALEXANDER GRAHAM BELL.

ON August 1 Dr. Alexander Graham Bell, one of the world's greatest inventors, died at the age of seventy-five years. The effects of early upbringing and environment always leave their mark on a man's life, and in Graham Bell's case they are specially apparent. His father spent the first half of his life as a lecturer on elocution at Edinburgh, and was also a prolific author of books on the same subject. Among his son's earliest experiments were the recording of speech waves on smoked cylinders. Graham Bell was a student at Edinburgh University, and later he assisted his father when the latter was a lecturer at University College, London. In 1870, for reasons connected with Graham's health, the family migrated to Brantford, near Tutela Heights, Ontario. In 1873 Graham was appointed professor of physiology at Boston University. In 1874 he invented a system of harmonic multiple telegraphy, and in that year he began a series of experiments which led him at last to realise in practice his conception of an articulating telephone.

Considering the marvellous results achieved the mechanism of the telephone is wonderfully simple. Previous to its invention, elaborate devices had been proposed containing large numbers of tuned reeds so as to cover the whole gamut of the human voice. The final form of the instrument is fully described in Graham Bell's patents of 1876 and 1877. Although he made several other notable inventions, the telephone will always be outstanding as his supreme achievement. It first attracted world-wide attention at the Centennial Exhibition in Philadelphia in 1876. After Graham Bell had laid down all the essential principles of telephony, Edison developed his carbon transmitter.

In 1878 the first telephone exchange was established. There are now about twenty-one million telephones connected with the various exchanges throughout the world. In the early days Graham Bell regarded twenty miles as the limit to which articulate speech could be sent. It has now been sent over five thousand miles.

In 1917 the Bell Memorial Committee presented to Brantford, Ontario, a public park, the house in which Graham Bell lived when he made his epoch-making discovery, and a noble monument, to commemorate the invention of the telephone. Graham Bell in his later years took the keenest interest in aeronautics and geophysics. When Father Cortie recorded the magnetic storm of August 11, 1919, in NATURE (vol. 103, p. 483), Graham Bell wrote to say that he had noticed a display of the Aurora Borealis at Cape Breton Island on that date, "Pulsations of light swept upward to the zenith resembling clouds driven before a heavy wind" (vol. 104, p. 74). He was made a doctor of science at Oxford in 1906, and in 1913 the Royal Society awarded him the Hughes medal and the Institution of Electrical Engineers made him an Honorary Member. On his visit to this country in 1920 the freedom of his native city of Edinburgh was conferred on him. He was held in universal esteem. As the founder of a great and flourishing industry which ameliorates the conditions of life he was a great benefactor to humanity.

A. R.

WORKERS in many branches of science and education will deeply sympathise with Prof. W. A. Bone, professor of chemical technology in the Imperial College of Science and Technology, on the death of his wife on July 26. Before her marriage to Prof. Bone in 1916, Mrs. Bone, who was then Miss Liddiard, was headmistress of the St. Albans High School for Girls, and had previously been a member of the teaching staff of the Ladies' College, Cheltenham. She was a graduate in arts of the University of London, and possessed exceptional capacity for teaching as well as for organisation. While she was head of the St. Albans High School, the domestic economy school was inaugurated there. Mrs. Bone took an active interest in science progress in general, and her husband's researches in particular, and her death will be regretted by a large circle of pupils and friends who came under her strong and delightful influence.

ORIENTAL learning has suffered a serious loss by the death, at the age of eighty-five years, of Mr. Charles Henry Tawney, C.I.E. Educated at Rugby and Cambridge, where he gained the highest classical honours, and a fellowship at Trinity College, Mr. Tawney joined the Indian Educational Service, and became professor at the Presidency College, Calcutta, where he won the esteem of his pupils by his kindness and learning. He became Director of Public Instruction in Bengal, and retired from the Educational Service in 1892. On reaching England he became librarian at the India Office. Much of his time was occupied in assisting writers on Indian subjects, by whom he was regarded with the greatest esteem. He was an admirable Sanskrit scholar, and published several works, the best known of which are translations of two great collections of Indian folk-tales, the Katha Sarit Sagara and the Katha Kosa, enriched with valuable notes, which displayed a wide knowledge of the literature of folk-tales. One of his sons, Mr. R. H. Tawney, Fellow of Balliol, is a distinguished writer and lecturer on economic problems.

WE regret to see the announcement of the death, on July 25, of Dr. Arthur Ransome, F.R.S., lately professor of public health in Owens College and examiner in sanitary science in the Universities of Cambridge and Manchester.

Current Topics and Events.

THERE appears to be solid ground for accepting as an accomplished fact the arrangement which was first rumoured in this country about a year ago. In its annual report, the Compagnie Nationale des Matières Colorantes, the French equivalent of the British Dyestuffs Corporation, declares that "all who understand the complexity of the manufacture of organic colouring matters will realise why we have been compelled to acquire the patents, the processes, and the technical aid of our principal foreign competitors for exclusive use in France." This passage has been taken by the French press as the official description of an agreement between the Compagnie Nationale and the Interessen Gemeinschaft, by which detailed technical assistance and full information regarding processes of manufacture shall be supplied to the French factories by their German rivals, such technical assistance taking the form of German chemists to supervise operation of processes in the French dye-works. In return for these advantages, the consumption of French dyes would be limited to France and her colonies, whilst the profits arising therefrom would be shared by the Interessen Gemeinschaft. Although a superficial view of this plan may not be flattering to national *amour propre*, the arrangement is an eminently practical one. The plain English of it is that a fifty years' start cannot be overtaken in fifty months. The Allies are agreed in declining to trust Germany with a virtual monopoly in dyestuffs manufacture such as she enjoyed before the war, in the first place owing to its military potentialities, and secondly, though not less forcefully, because a flourishing dyestuffs industry offers the most powerful stimulus to encouragement of national talent in the field of organic chemistry—a branch of science which civilised countries cannot afford to neglect. Consequently, it has appeared to the French better to enlist the assistance of Germans in building up a domestic industry than to incur the terrible risks of not having any dyestuffs factories at all. The course which they have chosen may perhaps, in a somewhat modified form, suggest an avenue of escape from British embarrassments in the same industrial domain.

A DEPUTATION from the People's League of Health, which recently waited on the Parliamentary Secretary to the Minister of Labour, in order to direct attention to the effect of unemployment and the unemployment insurance benefit on the health and habits of the nation, referred *inter alia* to the subject of nutrition. Sir Bruce Bruce-Porter said that the amounts paid by way of unemployment benefit were insufficient to keep the worker fit, that the latter was frequently unversed in food values, and would be better able to render good service when trade revived were he able to obtain a standard balanced diet by means of food tickets in part substitution for unemployment benefit. This point is of considerable importance, and although, as urged by the Parliamentary Secretary, there are serious administrative difficulties in the way of any such rationing scheme, we are of opinion that it ought to be considered seriously. The quantitative aspects of the problem of national nutrition need much more attention; we still have very little exact knowledge of the requirements of different classes of manual workers, and the foundations laid during the crisis of the war have not been built upon. We are glad to know that a strong committee, under the chairmanship of Prof. E. P. Cathcart, has been appointed by the Medical Research Council to examine the whole subject, and if possible undertake special research work. The food requirements of soldiers have been ascertained by exact experiment; the work of Cathcart and Orr in this field has been of the greatest value. The application of the experimental method to workers not under military discipline is difficult, while inferences from family budgets are frequently dangerous. However, a combination of the experimental method, applied to a relatively small number of selected individuals, and the statistical method of reducing budgets, will almost certainly lead to a solution of the problem. Similar remarks, of course, apply to the case of institutional dietaries—a subject under the consideration of a committee appointed by the Board of Control. It is doubtful whether the diets approved by various hospital and school committees are really based on any uniform scientific principles.

FROM the Royal Institute of British Architects we have received a notice of the preparations being made to celebrate the bi-centenary of the death of Sir Christopher Wren, who died on February 25, 1723, at the age of ninety-one years. The Royal Academy, the Royal Society, the British Museum, the London County Council, and other important public bodies are represented on the grand committee which has been formed, and the proposal is to have a commemoration week, beginning on Monday, February 26, 1923. The programme includes a memorial service, an exhibition, a pageant, and visits to Wren's buildings. Besides St. Paul's—the choir screen of which bears the oft-quoted inscription, *Si monumentum requiris circumspice*—Wren built about fifty City churches, and to him are also due the library of Trinity College, Cambridge, the Ashmolean Museum, Oxford, and Greenwich Observatory. Had Wren's career not been diverted to architecture, it is probable he would have been among the greatest scientific men of his age, such as Newton, Huygens, and Leibnitz. As a youth at Oxford he displayed remarkable ability, and gained the friendship of Wilkins, Boyle, Seth Ward, and others. In 1657, at the age of twenty-five, he succeeded Rooke as professor of astronomy in Gresham College, London, and three years later returned to Oxford as Savilian professor of astronomy. He was one of the founders of the Royal Society, and was president in 1680-81. Soon after being chosen Savilian professor he was given the sinecure post of assistant surveyor-general under Sir John Denham. The study of architecture,

however, soon engrossed him ; in 1665 he spent much time in Paris, where Bernini was building the Louvre, and the great fire of London gave him an opportunity such as has fallen to few men. Estimating the damage done by the fire at over ten million sterling, Wren drew up an elaborate plan for rebuilding the city with wide thoroughfares and open spaces, and was appointed "surveyor-general and principal architect for rebuilding the whole city."

DR. J. S. FLETT, Director of H.M. Geological Survey, will act as one of the delegates of the Geological Society of London at the International Geological Congress at Brussels on August 21 to September 3, in place of Prof. W. W. Watts, who is unfortunately unable to proceed to Brussels for the congress. The other delegates nominated by this society are Prof. E. J. Garwood, Vice-President, and Dr. J. W. Evans, F.R.S.

THE National Research Council of Japan has issued the first number of a new periodical, *The Japanese Journal of Geology and Geography* (Tokyo, 1922), which illustrates once more the wide outlook of science in Japan. In this number all the papers are in English ; they include one by Prof. Hayasaka recording for the first time the discovery of marine Lower Carboniferous strata in Japan, and one by Dr. Niiya, with admirable photographic illustrations, on the mud volcanoes of Mimbu, Burma. The abstracts of papers published in Japan form an especially valuable feature, since they are given in English or German, almost all in English, and serve to make known a wide range of researches published originally in the national language.

DR. MICHAEL GRABHAM has gone to Porto Santo, the northern island of the Madeira group, to study the conditions under which the local race of Portuguese inhabitants are said to enjoy complete immunity from dental caries. These people possess huge, ugly, yellow, but sound teeth, and Dr. Grabham proposes to bring specimens to London. The recent discovery that Porto Santo, which is almost bare of vegetation, has a desirable climate of its own and, moreover, a valuable spring of mineral water, is leading to the incursion of Madeira migrants, and it will be instructive to observe how contact with these new-comers will affect the tooth immunity which Dr. Grabham is investigating. Valuable knowledge may be thus obtained of a malady which in this country has become a national problem.

A PROVISIONAL programme has been issued for the autumn meeting of the Iron and Steel Institute, to be held on September 5-8 at York, under the presidency of Mr. F. Samuelson. A number of papers have been promised on subjects which, although within the range of the Institute's activities, are of varied character and give promise of an interesting meeting. Among the topics which will be dealt with are the changes in properties of steels during heat treatment, modern blast-furnace practice, moulding sands, high-speed steel as well as testing and works machinery. Arrangements have been made for members of the Institute to visit the works of the Staveley Coal and Iron Co. Ltd., near Chesterfield, and of the Parkgate Iron and Steel Co. Ltd., and there will also be excursions to places of interest in the neighbourhood of York. The secretary of the Institute would be glad to hear before August 15 from all who propose to attend the meeting.

IT is announced that proposals for closer co-operation amongst the leading engineering institutions, which have recently been under consideration, have now received the approval of the institutions, the representatives of which met in conference, namely, The Institution of Civil Engineers, The Institution of Mechanical Engineers, The Institution of Naval Architects, and The Institution of Electrical Engineers, and that an engineering joint council composed of representatives of these bodies has been formed. Among the objects of the joint council will be, to improve the status of engineers, to secure the better utilisation of their services in the country's interests and the appointment of properly qualified individuals to responsible engineering positions, and to prevent the unnecessary duplication of activities. It is anticipated that, at a later stage, the number of bodies represented on the joint council may be increased, but this at present remains a matter for future consideration for the joint council and the institutions concerned.

WE have received from the American Bureau of Standards, Washington, Scientific Paper No. 437, on the solubility of dextrose in water. It is shown from cryoscopic measurements that at temperatures below 90° C. three solid phases can exist—ice, α-dextrose monohydrate, and α-dextrose. The hydrate is stable between −5·3° C. and 50° C., and has a very high temperature coefficient of solubility. Copies of this paper may be obtained on request to the Bureau of Standards. From the same source we have also received Scientific Paper No. 435, on metallographic etching reagents for copper alloys, nickel, and the α-alloys of nickel, copies of which may also be obtained on application.

THE latest catalogue (No. 434) of Mr. F. Edwards, 83 High Street, Marylebone, W.1, is devoted to works on voyages, travels, exploration, and adventure in all parts of the world. The catalogue contains nearly 1300 titles. Many rare volumes are listed, including "The Antarctic Voyage of the *Erebus* and *Terror*," under the command of Capt. Sir C. J. Ross, 1839–43—The Botany and Zoology of the Voyage, by Sir J. D. Hooker, Sir J. Richardson, J. E. Gray, R. B. Sharpe, A. Günther, and others ; and Gabriel Thomas's "An Historical and Geographical Account of the Province and Country of Pensilvania and of West-New-Jersey in America," 1st edition. There is also a set of the "Journal and Proceedings of the Royal Geographical Society of London" from 1830 to 1919.

A LIST of the new books and new editions added to Lewis's Medical and Scientific Circulating Library during April, May, and June has just been issued. It is carefully classified and should be very useful for reference. Copies can be obtained free of charge from the publishers, H. K. Lewis and Co., Ltd., 136 Gower Street, W.C.1.

Research Items.

THE ORIGIN OF THE SWASTIKA SYMBOL.—The subject of the origin of the Swastika symbol has given rise to protracted controversy. The latest contribution to the question is that of Harit Krishna Deb in the Journal of the Asiatic Society, Bengal, 1921, No. 3. He suggests that it is a modification of the mode of expressing the ancient Hindu syllable Om, which is used in religious rites. This, a pothook with square ends, was duplicated, one across the other, to form the Swastika, meaning "bringer of blessings," which goes back in India to the seventh century, when it was used as a cattle-mark. Another reference is well before 528 B.C. It is found on gold leaf on a vase with relics of Buddha, and it appears on the Edicts of Asoka (273–232 B.C.). The earliest example known is on a spindle whorl from the third city of Troy, about 1800 B.C., and it is frequent in Greek vases about 600 B.C.

INDIAN PAINTING AND MOHAMMEDAN CULTURE.—The subject of Indian painting has recently attracted increasing attention, and its relation to Culture was discussed by Sir T. W. Arnold in the Sir George Birdwood Memorial Lecture recently delivered before the Royal Society of Arts. He illustrated its relation to Hinduism and Islam in the drawings of Musalman saints and Hindu ascetics; the etiquette of the Mughal Court and of social life, mainly derived from Persia; in the pictures of singers and dancers; of drinking bouts and feasts, and in the short-lived renaissance of Indian painting at the time when the Empire was breaking up. The importance of study of the subject, which would need a series of monographs, was emphasised by Lord Peel, the Secretary of State for India, and by Lord Ronaldshay, late Governor of Bengal.

SPAIN AND IRELAND.—In a lecture recently delivered before the Celtic section of the Société Internationale de Philologie, Sciences, et Beaux-Arts, London, Dr. W. Edmington Scott discussed the prehistoric relations between Spain and Ireland. He pointed out that the history of Iberian names for iron, lead, copper, tin, silver, mercury, gold, and several technical mining and metallurgical terms supplied evidence of long-standing trade communications between Spain and the Minoan and Ægean nations. Their presence in Old Irish pointed to Spanish intercourse with that island. The Phœnician exploitation of the Spanish mines lasted for nearly a thousand years, and it is possible that through these traders and colonists the Andalusian Basque names of the ores were introduced into Assyrian, Aramaic, Hebrew, and other Semitic languages. Tin ore was a necessity for the manufacture of bronze, and this undoubtedly came from the Cassiterides. The analysis of prehistoric Mycenæan, Cretan, and Trojan bronzes proved that they contained a high percentage of tin, whereas Homeric bronze was much weaker. This was due to the scarcity of tin, resulting from the cutting by the Phœnicians of the ancient trade route between Greece and Spain, and the consequent diversion of the mineral resources of the Peninsula to Western Asia.

HEALTH AND WEIGHT TABLES.—Two charts have been prepared by the director of the Galton Laboratory, Prof. Karl Pearson, which should prove of great value to those in charge of infant welfare centres and clinics ("Health and Weight Probabilities," Cambridge University Press, 7*s.* 6*d.*). The purpose of the charts is to compare the weight of an individual baby with the average at its age and to give a rough estimate of its chance of surviving the first year of life. Thus, suppose a female baby weighs 10 lbs. at the end of 36 weeks; according to the chart, 97 per cent. of females aged 36 weeks weigh more than 10 lbs. (the chart has been constructed from numerous data of working-class infants), and at the end of the year 74 per cent. of all babies will be healthier than this one. Of course, as Prof. Pearson has pointed out, predictions based upon a single character such as weight are not of a high order of accuracy, but these charts will be very useful. It will be easy to see whether an infant is maintaining or improving its grade of weight and health.

TURBINOID BONES OF *NOTOTHERIUM MITCHELLI*.—H. H. Scott and C. Lord have succeeded in recovering about one-half of the maxillo turbinals of *Nototherium mitchelli* (Studies in Tasmanian Mammals, No. vii., Papers Roy. Soc. Tasmania, 1922). Their general structure is akin to that of the turbinal of a wombat, but their coarseness of texture is about twice that which obtains in the living kangaroos. In being straighter, and more cuneiform in shape, the maxillo turbinals of the Nototherium approach those of the kangaroos and depart from those of the wombats. By reason of their more extensive vertical plates, they approach those of the wombats and depart from those of the kangaroos. By being preceded by a bony platform, the Nototherium turbinals manifest characters of their own, although such states are dimly suggested in the skulls of native bears. The authors conclude that there was a similarity in the lip muscles of Nototherium to those of Rhinoceros.

FLAGELLATES.—Mr. E. Penard gives (Proc. Acad. Nat. Sci. Philad., 1921) the results of studies on several flagellates. He describes in Pteridomonas the "flagellopodia," which may at one moment be flagella and at another form pseudopodia used in the capture of food—a rare condition in flagellates. *Dimorpha tetramastix* is, in the resting condition, a Heliozoon with fine radiate pseudopodia supported by axial filaments, and feeds on a minute ciliate which it captures with its pseudopodia. Arising from an anterior median depressed area are four very fine flagella, and by sudden retraction of the pseudopodia Dimorpha becomes a flagellate within the body of which traces of the axial threads of the former pseudopodia are visible. The organism swims by means of the flagella, but only for a short time, and on coming to rest reverts to the heliozoan form. Another new species of Dimorpha with only one flagellum is described, and this may also assume either the heliozoan or the flagellate form. The author has observed a flagellate stage of Chrysamœba and of Chrysopyxis; in each case the pseudopodia are retracted and a single flagellum is formed.

BIRDS AND SOME INVERTEBRATES OF CEYLON.—The outstanding contribution to the latest part of *Spolia Zeylanica* (vol. 12, part 45) is Mr. W. E. Wait's account of the passerine birds of Ceylon—a preliminary draft of a section for a proposed handbook on the birds of the island. In Ceylon the proportion of passerines in the avifauna is unusually small, for only about 120 species, about one-third of the total bird population, belong to this section, whereas in India fully half the species are passerines. The species are characterised in concise descriptions, followed by short accounts of distribution and habits, and keys are given to the distinctive characters of families and species. Two papers included in the part describe Ceylon Coleoptera—a new species of Luciola, and a collection of Lamellicornia; another continues a description of new species of Ceylon Diptera. Dr. Annandale has contributed a short

account of a polyzoon, *Plumatella longigemmis*, which occurred in the artificial lake whence Colombo obtains its water, and formed a continuous coating on the walls of the wash-water tank at the filtration works. Shorter notes deal with a new species of Lycænid butterfly (*Arhopala ormistoni*), with Lepidoptera of economic interest in Ceylon, and with the stridulation of a leaf-insect.

SURFACE TEMPERATURES IN THE NORTH SEA AND IN GERMAN LAKES.—The International Council for Marine Investigations has just issued a Bulletin Hydrographique (June 1922) containing a summary of all the observations of surface temperature in the North Sea during the years 1905–1914. There are more than 200,000 measurements made from commercial vessels and they are tabulated as means during each ten-day period for the mean year, and for areas of one degree of latitude and longitude, or for one-half degree, in each case. The results are represented graphically by a series of charts, one for each ten-day period. These show in a striking manner the "flow" of the isothermal boundaries throughout the year. A very interesting study of the temperature of the water at the surface of various lakes in Germany has been made by A. Merz (*Veröffentlich. Instituts für Meereskunde*, Berlin, N.F. A., Heft 5, 1920). A specially constructed thermometer was used. The bulb was a vessel of 1 sq. mm. cross-section and 12 cms. long; the capillary stem was 15 cms. in length and was bent at right angles to the elongated bulb. Thus it was possible to explore the water at depths varying by 1 mm. down to about 110 mm. The results are quite remarkable: on very calm days, when there is no vertical disturbance of the water, the temperature may vary from about 21° C. at the surface, to about 8° C. at a depth of about 100 mm. Probably these results will have much significance.

METEOROLOGY AT HONG-KONG.—The report for the year 1921 of the Director, Mr. T. F. Claxton, of the Royal Observatory, Hong-Kong, has just been issued. A heavy rainfall occurred from April 27 to July 6, a period of 71 days, rain falling on 59 days and yielding 59 inches, or 61 per cent. of the total fall for the year. From September 9 to the end of the year, a period of 113 days, the rainfall amounted only to one inch. The total rainfall for the year was 97·34 in. and the average for the past 38 years is 84·62 in. The greatest rainfall in a day was 6·06 in. and the greatest in one hour was 3·25 in. The highest shade temperature was 92° on August 22; the highest in the past 38 years is 97°. The lowest temperature was 44° on February 4, and the lowest for the 38 years is 32°. The maximum wind velocity for one hour was 51 miles; the maximum for one hour in the past 38 years is 108 miles. The maximum squall velocity in 1921 was at the rate of 69 miles an hour. There were 21 typhoons during the year and the tracks of these are given in the Monthly Meteorological Bulletin for December 1921. In addition to meteorological observations kept at about 40 stations in China, meteorological logs were received from 168 ships operating in the Far East, the latter being used for verifying typhoon tracks.

INTERFEROMETERS.—Because of the high degree of accuracy obtainable, interferometric methods of measurement are of extreme value in physical research. The application of such methods has been rendered easily practicable by the various Hilger interferometers, which are specialised developments of the Michelson interferometer. The manufacturers, Messrs. Adam Hilger, Ltd., 75a Camden Road, N.W.1, now include a list of these instruments in their catalogue and have issued separate booklets describing them. The prism interferometer, the lens interferometer No. 1, and the camera lens interferometer (described in NATURE, July 14, 1921) are fairly well known and are used in connexion with various physical problems. A simple and compact form of instrument known as the "interferoscope" is now also available, by means of which the degree of parallelism of surfaces of transparent plates can be determined with more ease and rapidity and with greater accuracy than by micrometer measurement. Minute differences in the thicknesses of opaque parts, *e.g.* steel thickness gauges, plug gauges, balls for bearings, etc., can also be conveniently measured by placing three of the parts between two glass surface plates and measuring the lack of parallelism in the separation of the plates. As the accuracy obtainable with this instrument is about one-millionth of an inch it should form a valuable test-room tool as well as a physical laboratory instrument.

CHEMICAL COMPOSITION OF THE EARTH'S CRUST.—Prof. W. Vernadsky of the Radium Institute, Petrograd, writing from the Paris Muséum d'histoire naturelle, says it has been shown by Oddo and Harkins that the outer shell of the earth's crust, down to a depth of about 10 miles, consists predominantly of elements with even atomic numbers, but he believes that it is now possible to go further than this, and that it can be shown that the elements of different atomic numbers can be grouped according to the part they play in the economy of the earth's crust as follows: 1. *Cyclic (biogenic) elements*.—These constitute 99·6 per cent. of the mass of the earth's crust, and 86·4 per cent. of them are elements with even atomic numbers. These elements enter into the composition of organisms, and the chemical changes they undergo are cyclic. They include the following 28 elements: Ag, Al, As, B, Ba, C, Ca, Cl, Cu, Fe, F, H, K, Mg, Mn, N, Na, Ni, O, P, Pb, S, Si, Sn, Sr, Ti, V, and Zn; and probably also the following 10 elements: Bi, Cd, Co, Cr, Hg, Mo, Sb, Se, Te, and W. 2. *Inert gases*.—These have all even atomic numbers. They are chemically inert. They include A, He, Ne, Kr, and Xe. 3. *Elements of the rare earths*.—These include Ce, Dy, Er, Eu, Gd, La, Lu, Nd, Pr, Sa, Tb, Tm, Yb. It is characteristic of these elements that they take no part in the formation of vadose minerals. 4. *Radioactive elements*.—These include Ac, Nt, Po, Ra, Th, and U. They are genetically related to uranium and thorium and are subject to disintegration. 5. *Inert metals*.—These include Au, Ir, Os, Pd, Pt, Rh, and Ru. They do not give vadose minerals. 6. *Diffused elements*.—These include Br, Cs, Ga, In, I, Li, Rb, Sc, and Tl. It is a marked characteristic of these elements that they show very little tendency to form minerals, although their atoms are widely diffused through the rocks of the earth's crust. All the elements of this group have odd atomic numbers. Prof. Vernadsky points out that the chemical processes going on in the earth's crust are closely dependent upon the atomic constitution of the matter of the crust. A portion of this is always in an active state, and is, under present conditions, to be regarded as a store of free energy; *e.g.* those cyclic elements that undergo changes through the influence of radiant solar energy, and those radioactive elements which give a continual display of atomic energy. So long as these sources of energy are maintained, chemical changes will proceed in the earth's crust as at present; but the equilibrium is slowly changing, partly through dissipation and partly through the disintegration of the radioactive elements.

The "Immured Standards" in the House of Commons.

AN interesting ceremony recently took place in the House of Commons, when the copies of the Imperial Yard and Pound which normally rest within the wall of the staircase leading up to the committee rooms, were replaced in their recess, and re-immured by cementing in place the stone slab covering the opening. These "immured standards," officially described as "Parliamentary Copies No. 4," constitute one of the four original sets of copies of the present primary standards of the yard and pound, and were constructed simultaneously with them in 1844–45, with the view of providing a ready means of replacement, should the originals at any time be lost or destroyed. Such a catastrophe occurred in 1834, when the Houses of Parliament were burnt down, the then existing standards being destroyed in the fire. The other sets of Parliamentary Copies were placed, and still remain, in the custody of the Royal Mint, the Royal Society, and the Royal Observatory, Greenwich. At a later date, a fifth set was provided for the Board of Trade, to obviate the necessity for using the primaries in important comparisons, as had been the practice hitherto.

Under statute, these copies must be compared with each other every ten years, and with the primary standards every twenty years, but the immured copies are expressly exempted from this requirement. Hence they have seldom been examined, and were only cursorily re-verified for the first time in 1892, when Mr. H. J. Chaney, the then Superintendent of the Standards, compared them with the Board of Trade copies, by means of apparatus which was taken to the House for the purpose. Since then they have not been disturbed until this year. Upon the present occasion, since this year marks the end of the twenty-year period, it was thought desirable to include the immured copies also in a complete set of inter-comparisons with the other copies and with the Imperial Standards themselves. With the kind consent of the Speaker, and in his presence, the recess was opened, and the standards taken out and inspected, before being removed to the Standards Department for verification. Upon the box there was found the certificate, in original, of their deposit in the present position, after the original site had been demolished during structural alterations. This certificate was dated March 7, 1872, and bore, among others, the signatures of Sir George B. Airy, Astronomer Royal, and Prof. W. H. Miller, both of whom had been closely concerned in the original construction of these standards.

All the comparisons in which the immured copies were involved having been completed, they were returned upon August 3. Mr. J. E. Sears, Deputy-Warden of the Standards, produced them for identification by means of their inscriptions, and after Mr. Percy Ashley, Assistant Secretary to the Board of Trade, had explained the general purpose of the ceremony, the Deputy-Warden announced the result obtained by comparing them against the Imperial Standards. They were then formally replaced in their boxes, which were then hermetically sealed up within a lead sheathing, within an outer oak box, and replaced in the recess, in which they were again immured by cementing the front stone in place. Upon the box there had been placed a record of the proceedings, signed by the principal witnesses, together with the original certificate above referred to, which had been found when the recess was opened.

The results of the comparison of the immured standards with the primaries were given by Mr. Sears as follows:

Yard P.C. No. 4 = Imperial Standard Yard − 0·000101 inch.

Pound P.C. No. 4 = Imperial Standard Pound + 0·00286 grain.

These figures are, however, provisional, since due weight will ultimately have to be given to the results of the other comparisons which are not yet completed, and some adjustment will therefore be necessary. It is interesting to compare these figures with those arrived at in 1844–45, when the standards were first constructed, namely:

Yard P.C. No. 4 = Imperial Standard Yard + 0·000007 inch.

Pound P.C. No. 4 = Imperial Standard Pound − 0·00314 grain.

The apparent variation in the yard is of the order of the differences which have been observed from time to time in the past among the other standard bars, but the apparent change in the pound is more considerable. It may perhaps be explained by the fact that the weight is by no means a good piece of metal, and of all the copies, it constitutes probably the one least fitted to form a trustworthy standard. Some evidence is, however, available, though it cannot be regarded as conclusive, that prior to 1878 the primary standard was rendered a little lighter by wear, arising from its relatively frequent use for important comparisons. The present series of comparisons may render it possible to form some conclusion as to whether this is the case.

The International Research Council.

A MEETING of the International Research Council was held at Brussels on July 25 and the four succeeding days, under the presidency of M. E. Picard, secretary of the Académie des Sciences, Paris; simultaneously the recently formed Union of Scientific Radio-Telegraphy held its first general assembly.

Twenty countries have now joined the International Research Council, the following seventeen being represented at the meeting: Belgium, Canada, Denmark, France, Great Britain, Greece, Holland, Italy, Japan, Norway, Poland, Portugal, Spain, Sweden, Switzerland, United States of America, and Czecho-Slovakia. The representatives of Great Britain for the general proceedings of the Council were Prof. J. R. Ashworth, Sir William Bragg, Sir Charles Close, Sir Richard Glazebrook; Mr. A. R. Hinks, Col. H. G. Lyons, Sir Arthur Schuster, and Dr. E. H. Starling; while in addition Admiral Sir Henry Jackson, Dr. Erskine Murray, and Mr. Shaughnessy represented, together with Sir Richard Glazebrook, the National Council for Radio-Telegraphy.

The greater part of the business of the meeting was concerned with the organisation of international scientific unions additional to the five for Astronomy, Geodesy and Geophysics, Chemistry, Mathematics, and Scientific Radio-Telegraphy, which are already in activity. As a result of the meeting the formation of Unions for Pure and Applied Physics and for Geography seems assured. The proposed Union in

Geology awaits the consideration of the Geological Congress which meets this week at Brussels, and some advance has been made in connexion with the biological sciences.

At a previous meeting of the International Research Council it had been provisionally agreed to unite medical and biological sciences; this decision did not find favour, and the intention now is to separate medicine from Physiology, Zoology, and Botany. Proposals will be submitted to the countries belonging to the Research Council, and the ultimate formation of this Union will depend on the number of countries willing to join.

Among other matters dealt with, a proposal submitted by the National Research Council of the United States of America and accepted by the meeting may prove to be an important addition to the responsibilities of the Research Council, which hitherto contented itself with the formation of Unions which became practically autonomous as soon as their statutes were approved. As problems in which several Unions were concerned ran a danger of being neglected, the proposal was now made by the United States that the Research Council itself should take such problems under its own special protection. Three inquiries were mentioned as likely to fall within this category. One of them had already been considered by the International Astronomical Union, which requested the Research Council to make arrangements for a collaboration of several of the Unions in the study of the correlations between solar and terrestrial phenomena. The second referred to the energy supply of the world (fuel, solar energy, etc.), while a third suggestion dealt with the difficult and complicated question of international patents. The risk of overlapping efforts and the possible fear of interference with the special work of the Unions is avoided by the provision—now coming into force—that the Executive Committee of the Research Council, which hitherto consisted of five members, should be enlarged, each Union nominating an additional member.

At the concluding meeting the five members of the Executive Committee appointed by the general assembly were elected as follows: M. E. Picard (President), Mr. G. Lecointe and Prof. Vito Volterra (Vice-Presidents), Dr. G. E. Hale, and Sir Arthur Schuster (General Secretary).

The Philosophical Congress at Manchester.

THE special subjects of discussion at the Philosophical Congress recently held at Manchester were (1) the nature of history and its differentiation from science, (2) the concept of unconscious mental process and the justification of the term unconscious in psychology, and (3) the philosophical aspects of the principle of relativity, particularly in regard to the problem of sense perception.

The vice-chancellor of the University of Manchester, Sir Henry Miers, presided at the opening meeting, when the Bishop of Manchester, Dr. William Temple, gave an inaugural address on "Symbolism as a Basis for Metaphysics." The particular function of philosophy is the interpretation of value. Reality presents itself in grades which rise in a hierarchical order from simple matter to life and mind and spirit. Each higher order is the imposition of a value on the lower on which it is dependent and which then becomes for it a symbol. Thus a flag as a parti-coloured strip of calico is mere matter and yet apart from the value which this matter symbolises it has not even the existence which supports the value. That is to say, though existence is prior to value, in the higher grade the distinction between existence and value disappears. This led to the further position that the universe can only be explained in terms of will. The intellect may be satisfied by a concept of the universe in terms of physical causation, but religious, æsthetic and ethical, and also scientific experience can only be satisfied by proof that it is purposively reasonable and not merely causally intelligible.

(1) "Are History and Science different kinds of Knowledge?" was discussed in a symposium by Mr. R. G. Collingwood, Prof. A. E. Taylor, and Dr. F. C. S. Schiller. The problem is an old one but has acquired new significance in modern thought. History is particular and individual, its events are unique, it is impossible to classify them and induce general laws. Is it then more than a simple chronicle? On the other hand, science deals with repetitions, its method is experimental, it formulates general laws which enable us to predict and so to control the future.

(2) The subject of the unconscious aroused the liveliest interest on account of its practical importance and the question of the methods of psycho-therapy which it involved. Prof. T. H. Pear presided over the discussion and referred to the great loss which psychology had sustained in the death of Dr. W. H. R. Rivers, who had taken part in arranging the programme and had expected to participate in the Congress. The meeting rose in silent tribute. The first symposium, "Is the Unconscious a Conception of Value in Psychology?" was by Mr. G. C. Field, Dr. F. Aveling, and Prof. J. Laird. In the discussion the medical point of view was represented by Dr. Mitchell and Dr. William Brown. The latter gave detailed instances of assumed mental processes which, judged by analogy, are indistinguishable from those of conscious life, the only difference being that the subjects in whom they occur are completely unaware of them. Mr. Leonard Russell on the philosophic side defended the use of the apparently self-contradictory term "unconscious consciousness" in a subtle argument directed to show that the paradox is not confined to a particular class of mental phenomena but extends to all, for even in what we call conscious process we are never conscious of the consciousness.

A second symposium on the terms used in the new psychology, "The Relations between Sentiments and Complexes," had six contributors. The first paper was by the late Dr. Rivers, the others were by Dr. Bernard Hart, Mr. A. G. Tansley, Prof. T. H. Pear, Mr. A. F. Shand and Dr. C. S. Myers. The practical issue in this discussion was as to a possible danger in psycho-analysis. Complexes were acknowledged to be harmful and psycho-analysis was directed towards dissolving them, but in doing so might there not be risk of dissolving sentiments which were wholly healthy?

(3) A discussion between Prof. G. F. Stout and Prof. Alexander on the nature of sense perception was preliminary to a more general discussion on a paper by Prof. A. N. Whitehead, "The Philosophical Aspects of the Principle of Relativity." The tendency of the new concept was, Dr. Whitehead said, distinctly to support the line of argument of those who followed Berkeley, and yet it was wrong to suppose that Einstein's principle implied or was even ultimately consistent with the full idealist

doctrine. The new law of gravitation quite as fully as Newton's law referred to a nature common to and independent of all individual minds. This was a necessity if there was to be physical science at all in any intelligible meaning of the term. The chairman, Prof. Wildon Carr, said that the idealistic interpretation of Einstein's theory did not imply that Einstein was an idealist or that any philosophical purpose was involved in his principle. The value of the new principle in philosophy depended on the fact that it was purely scientific and brought forward in the interest of mathematical physics. What it had done for philosophy was to show conclusively that the realist assumption of independent objective existence was not only unnecessary as a condition of the possibility of science but was a positive methodological hindrance.

Concurrently with the philosophical discussions the psychologists held a meeting in the psychological laboratory for the reading of papers and demonstrations.

On Saturday the British Psychological Society held separate meetings in the Medical School of the University. In the morning, with Prof. T. H. Pear in the chair, Dr. C. S. Myers described a number of experiments upon the various factors involved in the appreciation of music. He showed how closely the processes of listening to music may follow those involved in the response to pure tones, and considered especially the parts played in the æsthetic enjoyment of music by association, by a process of "distancing," and by "mystical feeling." Mr. F. C. Bartlett gave an account of some experiments leading up to a psychological study of the processes of conventionalisation; and Mr. R. H. Thouless discussed the phenomena of contrast in a smoothly graded disc. It was suggested that McDougall's drainage theory could scarcely be accepted as an adequate explanation of the contrast effects, a view that obtained support in the ensuing discussion. In the afternoon the Industrial Section of the Society held a meeting. Dr. Leslie Mackenzie presided. Mr. E. Farmer presented a new method of dealing with curves of output in factory work, and discussed the psychological significance of certain curves representing work in chocolate-packing and glass-blowing. Prof. A. V. Hill demonstrated his ergometer, and spoke to a large audience on characteristics of muscular work in the intact organism. Mr. Jackson read a paper prepared by Mr. S. Wyatt and himself on the effect of rest pauses upon output curves.

The Congress of the Royal Sanitary Institute.

THE thirty-third Annual Congress of the Royal Sanitary Institute at Bournemouth, which was held during the last week in July, displayed the multifarious character of the work embraced in sanitary science or public health. Special sections were devoted to sanitary science and preventive medicine, to engineering and architecture, to maternity and child welfare including school hygiene, to personal and domestic hygiene; and there were conferences of veterinary inspectors, health visitors, sanitary inspectors, representatives of sanitary authorities, and medical officers of health.

Major-General J. E. B. Seely's presidential address was an able summary of urgent public needs, an appeal for clean milk and for judicious expenditure on public health needs including housing, and a reiteration of the fundamental importance of education in advancing public health progress.

Sir Arthur Newsholme's presidential address to section I dealt with the relative rôles of compulsion and education in public health work. He laid down the following general principles as justifying compulsion in public health or social work: (1) that the end aimed at by compulsion must be very important for the public welfare; (2) that it cannot be achieved to an equal extent or within a reasonable time by educational measures, not including the education provided by education; (3) that the compulsion can be enforced; and (4) that it is continuously endorsed by a majority of the community. He gave examples of the fact that the social history of the 19th century consists largely in a steady extension of the enforcement of compulsory duties and restrictions in various aspects of communal life, each of which had been introduced to secure the larger liberty of the oppressed and handicapped members of the community; and then proceeded to apply these general principles to the case of two chronic communicable diseases like tuberculosis and syphilis, and to alcoholic indulgence. His general conclusion was that compulsion in these directions would be effective inversely to the extent to which it was needed; and that in the ultimate issue the two ideals of compulsion and of education of character are not irreconcilable in public health work.

In his address in the maternity and child welfare section, Sir George Newman stressed the continuing but avoidable loss of maternal and infant life, occurring through ignorance and still more through lack of care, and the still larger suffering and disablement of mothers and infants which might have been avoided. The fact that 35 per cent. of the children first admitted to the elementary day schools in England are so physically impaired as to need medical treatment, emphasises the importance of hygienic and medical care of the mother and of the infant before school age is reached. At the present time about 8*d*. per head is being spent on official services of maternity and child welfare, while the financial value of the lives saved by these services exceeds this sum many times over.

There was a useful discussion on "Fuel in relation to health" introduced by Prof. J. W. Cobb of Leeds University. In his paper Prof. Cobb traced the history of the stages through which the manufacture of gas for domestic purposes had passed. The New Gas Regulation Act had accepted the fact that the test of intrinsic luminosity was absolute, had permitted the distribution of gas of a lower calorific value than formerly, and had not laid down any limitation of the amount of carbon monoxide in gas. Evidently Prof. Cobb did not regard increase of carbon monoxide as necessarily increasing danger to the consumer, and he pointed out that although recently more cases of poisoning by this gas had been recorded, they could not be due to increase of its proportion, inasmuch as action in this direction so far had not been great.

In a paper on smokeless methods in Glasgow housing schemes Councillor W. B. Smith emphasised the too little recognised fact that soot from domestic fires is worse than that from boilers of manufacturing plants, on account of the excess of tar products, and advocated central provision of hot-water supplies in towns.

Lieut.-Colonel Clemesha described methods of collection and disposal of excreta suitable for small tropical villages, where, as a rule, there is a total absence of all sanitary arrangements. This leads not only to excessive cholera and enteric fever, but to the widespread dissemination of anchylostomiasis,

a parasitic disease, perhaps more destructive of health and efficiency than either cholera or malaria. It was necessary that the provision made for such villages should be primitive in character, and the "pit latrine" was the most satisfactory in most circumstances. Such latrines obviate the need for any conservancy staff and they greatly diminish surface contamination of the ground, and thereby reduce the possibility of spreading hookworm disease. Many of these simple arrangements have been in existence for hundreds of years in countries like Persia, Arabia, and Mesopotamia, and have given rise to no nuisance, but are in all respects satisfactory.

A few only of the subjects discussed at this Congress have been mentioned. The educational value of such meetings stands high. The Congresses of the Royal Sanitary Institute are unique in that they focus the views and wisdom of every profession and calling bearing on public health whether legal or medical, engineering or architectural, women workers voluntary or officials, medical officers of health or sanitary inspectors, veterinary and medical inspectors, representatives of sanitary authorities, and the workers in voluntary organisations. Out of exchange of outlooks from these various angles public health progress is secured.

Pharmaceutical Education and Research.

AT the British Pharmaceutical Conference, held at Nottingham on July 24-27, the President, Prof. H. G. Greenish, delivered an address on "Pharmacognosy and the Pharmaceutical Curriculum." Pharmacognosy, he said, was a field of knowledge that the pharmacist was peculiarly fitted to cultivate, but he would not be able to do so satisfactorily unless he had received a sound preliminary education and had been subsequently trained in chemistry, botany, physics, and elementary zoology. The entrance examination to pharmacy should, he thought, be raised to the level of matriculation, and the training in the sciences upon which pharmacognosy is based should follow and not precede the practical training in the pharmacy which is necessary before the student can present himself for the Qualifying Examination. Dealing with the course of instruction in botany, this, he thought, should be adapted to the object the student had in view, special attention being paid to anatomy, morphology, physiology, and systematic botany.

The training in pharmacognosy should be of a more general and more practical nature than was at present often the case, and should include the determination of diagnostic characters by means of the lens or the microscope or by qualitative chemical tests as might be requisite. In this respect a detailed syllabus was a disadvantage, as it restricted the freedom of thought and the development of a spirit of inquiry which was essential to true progress. In the advanced course of instruction and in the major examination more stress should be laid upon the identification of powdered drugs, the analysis of mixed powders, and the assay of drugs by chemical methods. Opportunity for post-graduate work was very necessary and every possible inducement should be offered to the student to undertake it. The Universities of Manchester and Glasgow had made arrangements for pharmaceutical subjects to form part of the examination for the degree of Bachelor of Science, and if the University of London could be induced to make a similar arrangement a considerable step forward would be made.

The student who had attended advanced courses of instruction in the selected subjects would then be in a position to take the degree of B.Sc. From this he could proceed without difficulty to the degree of doctor of philosophy, the requirement of the University of London being broadly two further academic years of study, including the presentation of a thesis on an approved subject. The work for the thesis could be carried out in an institution such as the research laboratories of the Pharmaceutical Society under teachers recognised by the University. The field of pharmacognosy is so wide, and the problems that await solution are so diversified in their nature, that no difficulty would be encountered in selecting subjects suited to the varied abilities of the students. Great assistance would be rendered in this work by the establishment of an experimental station similar to the Pharmaceutical Experimental Station of the University of Wisconsin at which the material necessary for investigation could be grown and experiments carried out. Possibly such a station could be established in connexion with one of the agricultural colleges.

The determination of the Pharmaceutical Society to foster its scientific work more in the future than it has done in the immediate past was one of the most hopeful signs for the future of pharmacy, and the society, by developing the work which pharmacists were specially trained to do, would go far to establishing its position as a learned society. The president concluded by saying that there might be obstacles to be surmounted, misunderstandings to dispel, and prejudices to be overcome, but the spirit of the pioneers of scientific pharmacy existed to-day and, though latent, was strong. The society should set its educational policy in the direction indicated by the wisdom of its founders and foster the love of the calling which distinguished its early years. So alone would pharmacy ensure for itself the appreciation of a nation.

University and Educational Intelligence.

LONDON.—Dr. George Senter, principal and head of the department of chemistry, Birkbeck College, has been selected by the University of London Graduates' Association as candidate for the vacancy in the representation of science graduates on the Senate of the University, caused by the election of Dr. Walmsley to the chairmanship of convocation. Dr. Senter was formerly a member of the Senate, and has for many years taken an active part in University affairs.

DR. WALTER RITCHIE, assistant lecturer in biology in the University College, Aberystwyth, has been appointed assistant lecturer in biology at the Technical College, Bradford, in succession to Mr. L. P. W. Renouf, who resigned his appointment on his election to the professorship of zoology in the University of Cork.

IN accordance with the terms of the will of the late Sir Archibald Dawnay, the Royal Institute of British Architects has awarded, for the first time, two scholarships, each of 50*l*. per annum for two years, to Mr. E. U. Channon, Architectural Association, and Mr. D. J. A. Ross, Robert Gordon's Technical College, Aberdeen; and one scholarship of 25*l*. per annum, for two years, to Mr. C. S. White, Architectural Association. The scholarships are intended to foster the advanced study of construction and the improvement generally of constructional methods and materials and their influence on design.

THE British Research Association for the Woollen and Worsted Industries announce the following awards of research fellowships and advanced scholarships for the year 1922–23: Mr. G. W. Chester, Liverpool, 200*l.* to conduct research on wool fats at the University of Manchester; Mr. John L. Raynes, Nottingham, 100*l.* to conduct research on the bleaching of wool at the University College of Nottingham; Mr. George Barker, Baildon, 100*l.* to conduct research on the action of water on wool as regards strength, elasticity, lustre, dyeing properties, etc., at the University of Leeds. Scholarships have been granted to Mr. Arthur Banks, Sutton Mill, Keighley, tenable at Bradford Technical College; and Mr. William B. Elliot, Wellington Road, Hawick, tenable at the South of Scotland Central Technical College, Galashiels.

THE Ministry of Agriculture and Fisheries announces that scholarships in higher agricultural education are offered to the sons and daughters of smallholders and agricultural and other rural workers. The scholarships are of three types: Class I. enabling the holder to attend the degree courses in agriculture at certain University departments (including the School of Rural Economy, Oxford, and the School of Agriculture, Cambridge); Class II., tenable for two years at certain University departments of agriculture and agricultural colleges; and Class III., tenable for one year or less, at a farm institute or similar institution. Candidates for Class I. and Class II. scholarships must be at least 17 years of age, and must show that they have sufficient ability to pass the entrance examination of the Institution at which the scholarship will be tenable; for Class III. awards, candidates must be more than 16 years of age and have spent at least a year on a farm or in a horticultural establishment. Applications should reach the Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, London, S.W.1, not later than August 31.

THE United States National Research Council has made an attempt to ascertain by statistics the relative support given to the arts and the sciences through fellowships and scholarships in the graduate schools of American universities. The result (Reprint and Circular series No. 29, 1922) points to the conclusion that the arts are in this respect more favoured than the sciences. Of 3377 fellowships and scholarships awarded during five years in the graduate schools of arts and sciences of twelve leading universities, 1892 were in arts subjects, 1289 in pure science, and 196 in applied science. The arts subjects were chiefly: English and modern languages (615), history (328), ancient languages (250), philosophy (198), economics (171), political science (153); the pure sciences—biology (400), chemistry (365), physics (152), mathematics (145), geology (104); applied sciences—engineering (105), agriculture (58). The figures do not, however, in any way indicate the extent to which applied sciences are encouraged in the universities, because they do not include the fellowships awarded in the professional schools. A comparison of the number of fellowships awarded with the number of doctorates conferred year by year in the natural sciences discloses in some cases a close parallelism between the two sets of figures; thus in California the numbers of fellowships and doctorates respectively in the five years 1916–17 to 1920–21 were: 23, 23; 16, 16; 15, 16; 21, 14; 25, 22; and in Stanford in 1918–19 to 1920–21: 2, 2; 4, 4; 5, 5. The total number of such fellowships in the natural sciences in the twelve universities during five years was 290, and the number of doctorates 248.

Calendar of Industrial Pioneers.

August 13, 1867. James Shanks died.—Trained at Glasgow University, Shanks abandoned medicine for practical chemistry and in 1836 was employed by Gossage in the erection of his condensing towers. He then became connected with the firm of Joseph Crosfield and Sons, Ltd., at St. Helens; among the notable improvements he made being the introduction of the "Shanks' Vats" used for the lixiviation of black-ash in the production of alkali.

August 14, 1909. William Ford Stanley died.—A native of Buntingford, Hertfordshire, where he was born in 1829, Stanley was trained in mechanics by his father, and in 1854 founded the well-known firm of scientific instrument makers. Besides effecting improvements in the design and manufacture of drawing and surveying instruments, he published standard works on their use and was a versatile writer on various scientific subjects. He was also an enthusiastic promoter of trade schools.

August 15, 1913. James Robson died.—Known for his pioneering work on the gas engine, Robson, who was born in South Shields in 1833, began life as an ironmonger and plumber. Turning his attention in 1855 to the internal combustion engine he built several successful gas engines, and in 1877 took out a patent for a two-stroke engine in which all the pumping and motor actions are performed by one piston in a single cylinder. Robson's first engine on the two-cycle plan was built at North Shields in 1879, and shortly afterwards their manufacture was taken up by Tangye's of Birmingham.

August 16, 1818. Jacques Constantin Périer died.—An able mechanician, Périer founded an engineering works, introduced steam-pumps and hydraulic presses into France, and became a builder of steam-engines. He also invented a centrifugal pump, and drew up a plan for the distribution of the water of the Seine throughout Paris. He published various scientific memoirs, and from 1784 was a member of the Paris Academy of Sciences.

August 17, 1809. Matthew Boulton died.—The founder in 1762 of the Soho Manufactory at Birmingham, Boulton was a successful toy and trinket maker. His friendship with Watt led in 1775 to the famous partnership which made the Soho works known throughout the industrial world. It was there that the modern steam-engine may be said to have had its birth, and much of the success achieved was due to Boulton's energy and business acumen. Boulton himself made many improvements in the art of coining.

August 18, 1874. Sir William Fairbairn died.—A great mechanical engineer, Fairbairn as a journeyman-mechanic gained experience in various parts of the country, and in 1817 set up in business in Manchester. He introduced many improvements in millwork, was a pioneer in iron shipbuilding, with Robert Stephenson built the Britannia Bridge over the Menai Straits, and made original investigations into the strength of materials, the properties of steam, and other subjects.

August 19, 1808. Frederic Henry Chapman died.—Recognised as the foremost naval constructor of his day, Chapman was born at Göteburg in 1721. As a young man he worked in London, and after visiting France became a constructor in the Swedish Service, and towards the end of his career invented the parabolic system of construction. His principal writings were his "Architectura Navalis Mercatoria" published in 1768 and a work on Ships of War published in 1775. E. C. S.

Societies and Academies.

EDINBURGH.

Royal Meteorological Society, July 24.—Dr. C. Chree, president, in the chair.—C. K. M. **Douglas**: Observations of upper cloud drift as an aid to research and to weather forecasting. The condition of the wind near the top of the troposphere in different stages of a cyclone is discussed. The pressure distributions aloft, disclosed by the upper winds, are considered in relation to temperature, as the pressure at considerable heights is largely determined by the temperature of the column of air underneath. There is complete lack of symmetry in the temperature distribution over a cyclone in its earlier stage, with a great contrast in the temperature of the whole troposphere between the "polar" and "equatorial" currents. When the cyclone becomes stationary and fills up, the distribution of temperature and wind in the upper air approaches to symmetry round the centre, and the easterly current on the north side often extends throughout the troposphere. No simple rules for weather forecasting can be drawn up, as the changes in the wind at considerable heights follow rather than precede those near the surface, but observations of high cloud motion are valuable, for they indicate the temperature distribution in the troposphere.—J. S. **Dines**: Note on the effect of a coast line on precipitation. A convergence effect occurs over a coast line when the wind blows along the coast, the low pressure being over the sea and the high pressure over the land; this may cause precipitation. Under favourable conditions an upward current of 15 feet per minute may be produced over a strip of the earth's surface extending 5 miles on each side of the coast line. A similar effect occurs wherever the pressure gradient varies along a line perpendicular to the isobars, and the following rule is deduced: "In any area where the pressure gradient increases towards the 'High' there will be rising air."—A. E. M. **Geddes** and C. A. **Clarke**: Note on turbulence, as exhibited by anemometer records, smoke and cloud formation. The effect of eddy motion is shown near the surface by the records from a pressure tube anemometer. The turbulence and consequent eddy motion depend largely on the nature of the surface over which the air current is travelling. Eddies higher up are shown by smoke from tall chimneys. Higher up, cloud of the stratus order is formed. Smoke eddies and clouds occur when there is little or no convection due to heated air, and therefore their appearance and formation is evidently in accordance with Taylor's theory of eddy motion. Eddies occur at the junction of two currents of different temperature, and fragments of cloud form below the base of the line squall or similar cloud. Cloud intermediate between the normal cirrus and cirro-cumulus types undergoes changes which are at present unexplained. The change of the cirro-cumulus type, regarded as a water-droplet cloud, into the ice-crystal structure of true cirrus is only to be expected at high altitudes and consequently generally very low temperatures, but the reverse process occurs frequently.

PARIS.

Academy of Sciences, July 10.—M. Emile Bertin in the chair.—Paul **Janet**: The standard reproduction of the international ohm. An account of the preparation of eight standard mercury ohms by the late M. René Benoît. The differences between the values measured by electrical methods and the values deduced from the geometrical dimensions did not amount to more than a few hundred-thousandths. The mean of the absolute values of the deviations was $1{\cdot}9\times10^{-5}$.—E. **Cartan**: A fundamental theorem of H. Weyl in the theory of metric space.—A. **Châtelet**: Finite Abelian groups.—J. **Guillaume**: Observations of the sun made at the Observatory of Lyons during the first quarter of 1922. Observations were possible on 74 days during the quarter; the results are summarised in three tables showing number and area of spots, their distribution in latitude and the distribution of the faculæ in latitude.—G. **Sagnac**: The oscillations of the spectral lines of double stars explained by the new law of projection of energy of light.—E. M. **Lémeray**: General relativity and the Milky Way.—R. **Jouast**: Comparisons of the standard reproductions of the international ohms. The standards constructed by the late M. René Benoît were compared by Kelvin's double-bridge method. Of the ten originally constructed one was rejected owing to an accident in mounting, and another had also to be rejected on account of an apparent discontinuity in the tube. Details of the measurements are given. The values range between 0·99984 ohm and 1·00015 ohm.—Vasilesco **Karper**: A particular class of batteries. A voltaic cell is formed by a mixture of amyl alcohol and water containing zinc sulphate in solution. This separates into two phases, the upper being amyl alcohol, the lower an aqueous solution of zinc sulphate. With zinc electrodes this cell gives an E.M.F. of 0·7 volt. The results obtained with this and similar cells are not in accord with Nernst's osmotic theory of cells, and appear to contradict the second law of thermo-dynamics.—P. **Janet**: Remarks on the preceding communication. It is necessary to prove rigorously that the cycle formed by the substances present constitutes a closed cycle.—Albert **Granger**: Observations on the baking of ceramic products in electrically heated furnaces. With platinum-wound furnaces the highest temperature attainable with safety is about 1300° C. For higher temperatures a granulated carbon resistance is necessary. A grey tint on the porcelain made in this furnace was proved to be due to the action of carbon monoxide passing through the wall of the tube (corundum mixed with a refractory clay).—R. **Locquin** and Sung **Wouseng**: Aldehydes obtained starting with tertiary alcohols.—F. **Boiry**: Vulcanising rubber in solution. A study of the interaction of indiarubber in colloidal solution and sulphur with different solvents at high temperatures (over 120° C.). With phenetol as solvent the compound produced contained 31·5 per cent. of sulphur, approximately corresponding to $C_{10}H_{16}S_2$ (32 per cent. sulphur), which may be considered as the ultimate product of vulcanisation.—Hervé de **Pommereau**: The reduction of ethyl α-naphthylacetate and of the α-naphthylethanols by sodium and absolute alcohol.—Emile **André**: Contribution to the study of grape seed oil. Study of the solid fatty acids. Method of separating stearic and palmitic acids.—A. **Duffour**: A new example of hemihedral forms not conforming to the sign of optical activity.—Gabriel **Bertrand** and **Mokragnatz**: The presence of cobalt and nickel in arable soil. The method of extracting these metals from the soil and identifying them is given in detail. A specimen of garden soil (Pasteur Institute) has given 0·0037 grm. cobalt and 0·0174 grm. nickel per kilogram of soil.—I. **Athanasiu**: Nervous motive energy. Electroneurograms.—A. **Desgrez**, H. **Bierry**, and F. **Rathery**: The state of acidosis. Method of proof and treatment.

CAPE TOWN.

Royal Society of South Africa, June 21.—Dr. C. F. Juritz in the chair.—S. H. **Haughton**: On some upper Beaufort Therapsida. A new genus of Cynodont reptile, Cynidiognathus, for the species *C. longiceps* based on a skull from the Burghersdorp Beds is described. Its dental formula is i4c1m10. There are well-marked palatine processes of the premaxillæ, no prevomers, and the epipterygoid is retracted from the quadrate. A skull thought to be *Cynognathus berryi* is assigned to the new genus under the name of *C. broomi*. The palate and basicranium of Ælurosuchus is discussed; the genus belongs to the Bauriamorpha.—T. J. **Mackie**: Observations on the protective action of normal serum in experimental infection with *Bacillus diphtheriæ*. In guinea-pigs experimentally infected with *B. diphtheriæ*, normal serum from various animals, injected subcutaneously at the same time as the inoculation, exerts a definite protective action. No protection occurs if the serum injection is delayed for 2 hours after the inoculation—the effect is prophylactic, not curative. The activity of the serum persists at 57° C., but is lost at 70° C. and higher. Serum from one guinea-pig injected subcutaneously into another is fully protective or exerts a delaying effect; it is noteworthy that serum of an individual of species highly susceptible to experimental *B. diphtheriæ* infection should be capable of affording some protection when injected parenterally into another animal of the same species infected with the particular organism. Normal horse serum is also protective in guinea-pigs injected with diphtheria toxin.—W. A. **Jolly**: Note on the electrogram of the frog's gastrocnemius reflexly excited. Records of the electrical change in the gastrocnemius when contraction is elicited reflexly by mechanical stimulation of the heteronymous foot, show that the response of the muscle is of the nature of a tetanus.—J. S. **van der Lingen**: Note on a cystoscopic irradiator and an ultra-violet light illuminator. The illuminator consists of a lens-system, of two quartz lenses and an iris diaphragm, whereby a field may be illuminated with any desired group of ultra-violet waves. One irradiator takes the form of a quartz-rod or tube shaped like a cystoscope, and the illuminator, by which rays are passed into the organs to be illuminated. The rays pass out only at the spherical tip. The other form consists of an exhausted tube bent into the form of a cystoscope, with a bulb at the external end containing a small quantity of mercury. Carbon-monoxide is introduced into the tube by heating, and this causes the mercury to radiate at a low temperature, when a high-frequency field oscillates in a helix placed over the external end of the tube.

SYDNEY.

Linnean Society of New South Wales, May 31.—Mr. G. A. Waterhouse, president, in the chair.—G. D. **Osborne**: The geology and petrography of the Clarencetown-Paterson district. Pt. 1. The descriptions are based upon an exhaustive survey of about 200 sq. miles containing rocks of the Burindi Series, Kuttung Series and the Cainozoic System. It is suggested that the Kuttung Series be divided into a basal stage, a volcanic stage, and a glacial stage in consequence of modifications found in the general sequence, the most important of which is the discovery of glacially-produced rocks on a much lower stratigraphic level than hitherto recognised. Five detailed sections of the volcanic stage are described. The work confirms the broad stratigraphical succession as given by C. A. Sussmilch.—G. F. **Hill**: Descriptions and biology of some North Australian termites. Four new species and two hitherto undescribed castes of the genera Eutermes and Hamitermes are described.—J. B. **Cleland**: A second bird census.—A census of the numbers of species and individuals observed on a series of journeys in various districts. The districts covered are southern coastal Queensland, Blue Mts., N.S.W., South Western Plains, N.S.W., Adelaide and Renmark Districts, S.A., and the Central Northern District, S.A.

Royal Society of New South Wales, June 7.—Mr. C. A. Sussmilch, president, in the chair.—A. R. **Penfold**: The isolation and identification of the acid bodies produced by the oxidation of piperitone by means of potassium permanganate. The ketone used was from *Eucalyptus dives*, and three acids were identified.—M. **Henry**: The incidence of anthrax in stock in Australia. Introduced originally about eighty years ago, anthrax attained serious proportions in certain districts, but during the last thirty years there has been a decline in the area infected. The disease has always been definitely localised. It was introduced near Sydney and carried inland and into Victoria but then disappeared from its original areas. At present most of the coastal districts, the tablelands and the Western Division of New South Wales are anthrax free. The real anthrax country consists of a belt in the western slopes; in Victoria there is a similar belt. Queensland is free, and possibly was never affected, and in the rest of Australia the disease is negligible. The season of greatest danger from anthrax is the summer and early autumn. The mortality from it is not heavy. There is an inhibitive factor which has prevented anthrax becoming more widespread. Among human agencies the controlling factors have been vaccination, quarantine, destruction of carcases by fire, breaking up of large estates, and substitution of agricultural for pastoral activities. Contaminated coil is generally the source of infection; infected feeding-stuffs, the common source of infection in England, do not operate.—E. **Cheel**: (1) Notes on the species of *Darwinia Homoranthus*, and Rylstonea in the states of New South Wales, Victoria, South Australia and Queensland. The plants are known as "Fringe Myrtles" or "Scent Myrtles," and are said to be of importance on account of the essential oil contained in the leaves. The plants known as *Darwinia taxifolia* are very variable and great care is necessary in the selection of material if pure grades of oil are required. Plants originally collected at Rylstone and given the name Rylstonea are probably forms of *Verticordia darwinioides*. (2) Notes on *Melaleuca linariifolia* and *Melaleuca trichostachya*. These species are commonly known as "Tea Tree" and "Tee-doo" respectively, and are also said to be of importance on account of the essential oil contained in the leaves

Official Publications Received.

Imperial Department of Agriculture for the West Indies. Report on the Agricultural Department, St. Kitts-Nevis, 1920–1921. Pp. iv+33. (Barbados.) 6*d*.

Department of Agriculture, Trinidad and Tobago. Administration Report of the Director of Agriculture for the year 1921. Pp. 12. (Port-of-Spain, Trinidad.) 6*d*.

On the State of the Public Health: Annual Report of the Chief Medical Officer of the Ministry of Health for the year 1921. Pp. 115. (London: H.M. Stationery Office.) 1*s*. 6*d*. net.