Nature

A WEEKLY

ILLUSTRATED JOURNAL OF SCIENCE

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

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NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

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

THURSDAY, MARCH 6, 1919.

THE LIFE-WORK OF A HINDU CHEMIST.

Essays and Discourses. By Sir Prafulla Chandra Rây. With a Biographical Sketch and a Portrait. Pp. xxxii+349. (Madras: G. A. Natesan and Co., 1918.) Price 3 rupees.

SIR PRAFULLA CHANDRA RÂY, professor of chemistry in the Presidency College, Calcutta, is well known to chemists in this country as the author, either alone or in collaboration with his pupils, of more than a hundred papers, chiefly on the inorganic and organic nitrites, published in the Transactions of the Chemical Society, in Continental journals, or in the Journal of the Asiatic Society of Bengal. In his own country he is also known as the founder of a successful chemical industry, which, from small beginnings, now occupies factories spreading over an area of eight acres. It is one of the most successful concerns in India, and proved of considerable service to the Government during the war, when the supply of Western chemicals and drugs was seriously interfered with. It is entirely staffed with Bengali workers, and its research chemists are of its creator's training.

Naturally, such a man has had a great influence in India. He has succeeded in founding a school of native chemists capable of attacking and elucidating modern scientific problems. He has roused and quickened the Bengali brain from the torpor which had overtaken it, and by his example and precept has proved that the Hindu only needs training, encouragement, and direction to revive the ancient glories of his race in philosophy and science. The success of the commercial undertaking which he initiated also indicates that the Bengali is not lacking in the power of organisation, application, and steadfastness of purpose needed to conduct successfully a business enterprise.

It was to be expected, therefore, that Sir P. Chandra Rây should, as he expressed it, sooner or later find himself "the property of anybody and everybody," and be called upon by various educational institutions, by conferences, and by the periodical Press and leading newspapers interested in the social reform and development of the industrial and political life of India to address his countrymen on subjects which so closely affect their national welfare and prosperity; and it was equally certain that a demand should arise that these essays and discourses should be collected and published in some permanent form.

The little book before us is the outcome of this demand. It contains a series of addresses and articles on scientific education in India; on the pursuit and progress of chemistry in Bengal; on science in the vernacular literature; on the antiquity of Hindu chemistry; on the Educational Service of India; on the Bengali brain and its misuse; on Government and Indian industries, together with a number of appreciations of men who have signalised themselves in the national evolution of India.

The collection is prefaced by a short biographical sketch of the author, and concludes with a list of original contributions from the Indian School of Chemistry.

Such a book, as a literary production, cannot be judged wholly from a Western point of view. To do justice to it one must have some knowledge of, and sympathy with, the Oriental mind. Its language is at times suffused with a glow characteristic of the East, and its excessive eulogy and altisonant phrases, as Evelyn would have styled them, are apt to provoke a smile in the stolid and more cold-blooded Englishman. At the same time, it is impossible not to recognise and appreciate the earnestness, courage, and sense of duty of the author, or fail to perceive his sincerity or the strength of his convictions in warring against the galling restrictions of caste, of social inequalities and depression, which are at the bottom of India's degradation. Her elevation will not come in Sir P. Chandra Rây's time. A small, spare man, in feeble health, and a con-

firmed dyspeptic, he will be spent in her service. But the memory of these services will survive, and the little book to which we direct attention will serve to perpetuate it.

T. E. THORPE.

GRAVITATION AND RELATIVITY.

The Physical Society of London. Report on the Relativity Theory of Gravitation. By Prof. A. S. Eddington. Pp. vii+91. (London: Fleetway Press, Ltd., 1918.) Price 6*s*. net.

IN the year 1905 a paper was published by Dr. A. Einstein which gave to the world of physical science a new subject for controversy under the title of "The Principle of Relativity." For ten years discussion reigned between those who held to the æther as a firm basis to the universe, and those who, treading more mathematically, felt a safer foothold on Einstein's elegant abstraction, little caring that æther, space, and time all trembled.

While men talked, the author of the disturbance was quietly preparing a greater. His first effort had left to the materialist a little comfort and cause for self-conceit in that it had not succeeded in resolving the old contradiction between a metaphysical theory of the relativity of space and time and the apparent existence of an absolute standard of rotational motion. The new theory, however, claims, not only that the complete relativity of space and time is true to the facts, but also that it can throw light on gravitational phenomena which was not shed by the more limited principle. To quote the author of this report: "*Einstein's theory has been successful in explaining the celebrated astronomical discordance of the motion of the perihelion of Mercury without introducing any arbitrary constant; there is no trace of forced agreement about this prediction.*"

Any theory of gravitation which succeeded in doing this would be worthy of serious consideration, but what words should be applied to one which transcends the limitations of Newton's marvellous achievement through the acceptance of the doctrine of complete relativity of space and time?

In the earlier theory the one essential constant and invariant magnitude was the velocity of light (*c*). In mathematical signs, $dx^2+dy^2+dz^2-c^2dt^2$ was invariant. It is obvious that this cannot be so for a complete relativity, but a general quadratic expression in *dx, dy, dz, dt* will remain through all changes an expression of the same type, though the coefficients of the several terms will be functions of position and time instead of constants. In the new theory it is assumed that the physical properties of space are such that there is a quadratic form of this kind which remains invariant. The physical state at any point and instant is summarised in the values of the coefficients. It is Einstein's achievement to have been able to apply the work of the pure mathematician to find equations between these quantities which, while reducing to the equations of Newtonian gravitation for all frames of reference to which the old principle of relativity applies, have a completely invariant form.

While we wonder at the feat, and at the vision of a hitherto uncomprehended unity of thought, there remain some obstinate questionings. If this dream of complete relativity be true we are getting near the point at which it is so general as to lose touch with common experience. The new law of gravitation has not that astounding simplicity of expression which distinguishes that of Newton. The old problem of absolute rotation is thrown further back; but it remains true that there are systems of reference for which dynamical phenomena present their greatest simplicity. We ask why our first naive choice of a system of measurement ready to hand is such that within it material bodies have a nearly permanent configuration, and light has an approximately constant velocity.

Generalisation is the supreme intellectual achievement, but it may leave us thirsting for the particular and for simplicity. This report on what may be the most remarkable publication during the war leaves us wondering in which direction the greater satisfaction is given.

OUR BOOKSHELF.

Mnemonic Notation for Engineering Formulae. Report of the Science Committee of the Concrete Institute. With explanatory notes by E. F. Etchells. Pp. 116. (London: E. and F. N. Spon, Ltd., 1918.) Price 6*s*. net.

THIS book contains a series of miscellaneous papers dealing with the application of mnemonic notation to various branches of pure and applied science, and especially to structural engineering. The formulæ of science should not be expressed in misleading symbols which are not suggestive of the quantities concerned, but in a notation which is the "embodiment of organised common sense." The key to the notation adopted is to be found in the abbreviation of the significant words in any term until only the initial letter remains. In a few instances the second, or even the final, letter may be retained to form a subscript to the initial letter. "The *greater* letters are used to indicate *greaterness* of quantity or *greaterness* of complexity."

There is no doubt that the scheme proposed is founded on sound principles, which have been long recognised by competent teachers. To some it may seem that in parts of the present volume there is a tendency to elaborate the obvious, and that the report would have been more convincing if there had been fewer repetitions and less frequent use of odd and unfamiliar language. A series of useful appendices dealing with various practical questions, such as calculations for business purposes and the printing of mathematical formulæ, occupies more than two-thirds of the book.

The British Journal Photographic Almanac and Photographer's Daily Companion, 1919. Edited by George E. Brown. Pp. 644. (London: Henry Greenwood and Co., Ltd., 1918.) Price 1*s.* 6*d.* net.

IT is very satisfactory that this annual has survived the war, for it is indispensable wherever photography other than mere routine work is actively carried on. The present volume is the fifth issued since August, 1914, and suffers the most severely of all from the restrictions that necessity has imposed upon us. However, even this is a substantial volume, in which none of the main features that we have been led to expect are omitted. The article by the editor is on "Photographic Definitions," and these are arranged according to subject in a series of sections, each of which is a kind of running commentary on the subject of its title. The commercial uncertainty of the present time is shown by the comparatively few prices that are given in the advertisements. The most useful section to the student, the "Epitome of Progress," shows that notable advances have been made in the science of photography, as well as in the prices of materials. We regret that formulæ for the use of metol and glycin as developers are not given. Metol, certainly, is as generally useful as ever it was. Perhaps these were removed because of their "enemy origin," but they have for some time been "British-made," and figure in at least two or three places in the advertisement pages.

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 Directorship of the Natural History Museum.

THE Director of the British Museum (Natural History) is about to retire, and we learn with deep apprehension that the principal trustees, with whom the appointment rests, have received, or are about to receive, from the general body of trustees a recommendation to pass over the claims of scientific men and to appoint a lay official, who is at present assistant secretary. The former directors, Sir Richard Owen, Sir William Flower, and Sir Ray Lankester, like the present director, Sir Lazarus Fletcher, were all distinguished scientific men. The Natural History Museum is a scientific institution. There is a large staff of scientific keepers and assistants. The director has to represent natural history to the public, to other scientific institutions at home, in the Dominions and Colonies, and in foreign countries, and to the many Government Departments with which the museum has relations. He must represent it with knowledge and authority. There are few posts with such possibilities of advancing the natural history sciences, of making them useful to the nation, and of interpreting them to the public. The existence of the post is a great stimulus to the zeal and ambition of zoologists and geologists.

The arguments alleged in favour of the recommendation are trivial. It is stated that a former director was allowed by the trustees to leave the administrative details to the member of the clerical staff whom it is proposed to promote, that he performed these duties with ability, and during the tenure of the present director retained and extended his powers. It is urged that the tenure of the new director would be short, as he would have to retire in two years under the age limit. It is pleaded that promotion would entitle him to a larger pension, and that he need not be called director, but only acting-director.

Plainly, if the assistant secretary be the only man who knows the details of administration, it is important that the permanent director should be appointed at once, in order to have the opportunity of learning them before taking them over. In actual fact there is nothing in the administrative work of the directorship that could not be learned in a few weeks or months by any person of ordinary intelligence. At least two of the present keepers are eligible for the vacancy, have attained the necessary scientific standing, and have ample experience of the museum itself. To pass over these or several eminent and eligible men not on the staff in favour of one of the ordinary office staff would be an affront to scientific men and of grave detriment to science.

W. BOYD DAWKINS, F.R.S. (Honorary Professor of Geology and Palæontology, Manchester).
J. COSSAR EWART, F.R.S. (Professor of Natural History, Edinburgh).
F. W. GAMBLE, F.R.S. (Professor of Zoology, Birmingham).
J. S. GARDINER, F.R.S. (Professor of Zoology, Cambridge).
WALTER GARSTANG, D.Sc. (Professor of Zoology, Leeds).
E. S. GOODRICH, F.R.S. (Aldrichian Demonstrator of Comparative Anatomy, Oxford).
W. A. HERDMAN, F.R.S. (Foreign Secretary, Royal Society, Professor of Natural History, Liverpool).
S. J. HICKSON, F.R.S. (Professor of Zoology, Manchester).
J. P. HILL, F.R.S. (Jodrell Professor of Zoology, London).
W. E. HOYLE, D.Sc. (Director, National Museum of Wales).
ARTHUR KEITH, F.R.S. (Hunterian Professor and Conservator of the Museum of the Royal College of Surgeons).
J. GRAHAM KERR, F.R.S. (Regius Professor of Zoology, Glasgow).
E. W. MACBRIDE, F.R.S. (Professor of Zoology, Imperial College of Science).
W. C. MCINTOSH, F.R.S. (Emeritus Professor of Natural History, St. Andrews).
J. E. MARR, F.R.S. (Woodwardian Professor of Geology, Cambridge).
P. CHALMERS MITCHELL, C.B.E., F.R.S. (Secretary, Zoological Society of London).
E. B. POULTON, F.R.S. (Hope Professor of Zoology, Oxford).
R. C. PUNNETT, F.R.S. (Arthur Balfour Professor of Genetics, Cambridge).
A. C. SEWARD, F.R.S. (Master of Downing College, and Professor of Botany, Cambridge).
A. E. SHIPLEY, F.R.S. (Master of Christ's College and Reader of Zoology, Cambridge).
W. J. SOLLAS, F.R.S. (Professor of Geology, Oxford).
JETHRO J. H. TEALL, F.R.S. (lately Director of the Geological Survey of Great Britain).
J. ARTHUR THOMSON, LL.D. (Professor of Natural History, Aberdeen).

February 27.

The Supposed "Fascination" of Birds.

It is well known that the stoat (*Putorius ermineus*) sometimes performs extravagant antics by way of ruse in approaching rabbits or small birds, which, in the opinion of some persons, are "fascinated" or hypnotised by the display. I incline to believe that the subject of these manœuvres becomes so deeply interested, amused, or puzzled by the movements of the acrobat that it defers flight until too late. This view has been strengthened by what I witnessed from my library window in the spring of 1917. A male blackbird was sitting on the open lawn; a stoat was racing round the bird at high speed, now rolling itself into a ball, racing again, then leaping fully 2 ft. high and turning an aerial somersault, and again racing in circles. How long the performance had been going on before I happened to become a spectator I know not, but it went on under my eyes for perhaps seven minutes, during which time the blackbird never stirred and the stoat continued in violent movement. Every moment I expected that it would spring upon the bird, which it might easily have done, but nothing of the kind happened. Suddenly, in the middle of the performance, the blackbird flew away; and the stoat, apparently not caring to exhibit without a "gallery," resumed its normal gait and disappeared in the bushes.

Now if the blackbird was "fascinated" in the sense of an arrest of motor volition, what broke the spell? The acrobat was at the height of its antics when the bird flew off. One may assume, I think, that the latter's interest in the performance was absorbing up to a certain point, for it is contrary to the habits of a blackbird to sit motionless for many minutes on a spring morning; but it does not seem as if its volition had been affected.

In his great work on British mammals Mr. J. G. Millais describes instances of the stoat (than which there is no more bloodthirsty animal) resorting to these acrobatic feats with no deadly purpose, finishing up by romping with its audience of young rabbits and worrying them in make-believe. In the case I have described it does not appear that the stoat had any intention of making its breakfast off the blackbird.

HERBERT MAXWELL.

Monreith, Whauphill, Wigtownshire, N.B.

Girvanella and the Foraminifera.

BULLETIN No. 104 of the United States National Museum contains the first part of Mr. J. A. Cushman's "Foraminifera of the Atlantic Ocean." Workers in this group will find it of much value to have a complete and well-illustrated account of the foraminifera as occurring in the Atlantic. In this paper there is, however, one doubtful point in regard to affinity in which two distinct organisms are confused, and this, if not corrected, will mislead the student. I refer to the relegation of Brady's *Hyperammina vagans* to the genus Girvanella, Nicholson and Etheridge. It is a generally accepted opinion that Girvanella is probably related to the blue-green algæ (Cyanophyceæ), as shown by Rothpletz, Wethered, Seward, Garwood, and the writer. In the earliest descriptions Nicholson and Etheridge, it is true, held Girvanella to be of foraminiferal affinities, and Brady compared it to *H. vagans*, but the consensus of opinion is now in favour of its plant origin. As I have elsewhere shown (Aust. Assoc. Adv. Sci., Adelaide, 1907), its larger dimensions, arenaceous shell-wall, bulbous primordial chamber, simple, not branching, tube, and absence of septation separate it from Girvanella. In following Rhumbler (1913), Cushman includes other species of thread-like rambling and attached organisms. Whether they are all foraminiferal or algal in affinities can be determined only by careful examination by means of microscope sections, at the same time bearing in mind that the structure of the true Girvanella tube is not a mosaic of particles held by cement, but a finely granular structure such as is seen in other living calcareous algæ. The point here raised is directed against the placing of the genus Girvanella, as defined by Nicholson and Etheridge, with the Foraminifera.

FREDK. CHAPMAN.

National Museum, Melbourne,
December 23, 1918.

Feeding Habits of Nestling Bee-eaters.

THE paragraph in NATURE of March 28, 1918, p. 70, upon a paper in which Mr. W. Rowan describes the defæcation of the nestlings of the British kingfisher, leads me to mention the habits of a bird also nesting in tunnels. I refer to the bee-eater (Merops). Mr. J. E. Ward, recently a fellow-passenger from New Guinea, told me that the young of a Papuan species defæcate outside the nest but within the tunnel. The fæces attract flies, which breed in the mass, and the resulting larvæ form the food of the very young nestlings. As the flies later emerge, the young birds have grown sufficiently to be able to catch the insects on the wing.

Mr. Ward noticed that nestlings in captivity did not gape for food as do most young birds, and he was thus led to investigate the subject, with the result above mentioned.

EDGAR R. WAITE.

S.A. Museum, Adelaide, September 6, 1918.

Aeronautics.

THE COMMERCIAL USE OF AIRSHIPS.

THE future of the rigid airship from the commercial point of view is brought prominently into notice by a paper lately issued by the Air Ministry entitled "Notes on Airships for Commercial Purposes." This memorandum discusses at length the possibility of the use of airships in the immediate future, and enters into a detailed comparison between the large aeroplane and the rigid airship. At the outset it is stated, however, that the two types of aircraft, as at present developed, are not likely to compete with one another seriously, since their characteristics are widely different, the aeroplane being essentially a high-speed, short-distance machine, while the rigid airship is a long-distance, weight-carrying craft. The great endurance of the airship and its power of remaining in the air during a temporary breakdown of the machinery are valuable assets when long flights over sea or mountainous country are contemplated. The safety and comfort of passengers are considered to be greater in the case of the airship than in that of the aeroplane. In connection with the possibility of loss by fire in the former case the Air Ministry points out that there has been only one such loss since 1914, despite the fact that about 2½ million miles have been covered, and that in this one case the cause of fire has been ascertained and eliminated. It is conceded that at present the airship is more affected by bad weather than the aeroplane, but it is stated

that up to the end of November there were only nine days in 1918 on which no airship flight took place in the British Isles.

Having thus indicated the suitability of the airship for commercial purposes, the paper goes on to discuss the developments which have taken place during the last four years in the design of both airships and aeroplanes, and it is considered that the development of the airship has been even more marked than that of the aeroplane when regarded from the point of view of weight-carrying. Considerable emphasis is laid on the fact that for a given increase in the gross weight of an aeroplane a more than proportional increase is necessary in the weight of the structure itself if the same factor of safety is to be maintained; whereas in the case of the airship the strength of the structure is maintained if the structural weight is directly proportional to the gross weight. This difference is explained by the fact that the lift of similar aeroplanes is proportional to the square of their linear dimensions, whereas the lift of similar airships varies as the cube of the dimensions. If, therefore, the size of aeroplanes is increased very greatly, while still adhering to the present materials and constructional methods, a point would be reached where the machine could only just lift its own weight, with no reserve for carrying useful load. With the airship, however, the useful load increases continuously, no matter how large the ship.

It therefore appears that, while airships of great carrying capacity are theoretically possible on the present lines of design, it is impossible to build aeroplanes to carry anything like the same loads unless methods of design can be radically altered. A comparison of this kind is not necessarily an argument in favour of the airship, as it may be ultimately found better to carry a given load by a number of aeroplanes of reasonable dimensions rather than by a single huge airship.

Numerical illustrations are given of the improvement since 1914 in the cases of aeroplanes and rigid airships, and a rough indication of the results arrived at is given in the table below:—

Type of aircraft	Speed (miles per hour)	Horse-power	Useful load (tons)
1914 Avro	70	80	0·27
1918 D.H. 10A	125	810	1·45
1914 Zeppelin (average) ...	50	800	8·5
1918 Zeppelin (L.70) ...	78	2100	38·8
Proposed 10,000,000 cu. ft. rigid airship	86	6000	170

The table shows the possibilities of the airship as a weight-carrier in a marked manner, but it is somewhat difficult to make a comparison of merit when the size and the speed of flight are so variable for the various aircraft. If it be assumed that the horse-power varies as the cube of the speed (an assumption which is true for the airship, and approximately correct for the aeroplane), it is possible to compare roughly the performances by noting the value of $\frac{WV^3}{\text{horse-power}}$ for the various craft, where W is the useful load in tons, and V the speed in miles per hour. For the five machines above considered, the values are:—

1914 Avro	1,100
1918 D.H. 10A	3,300
1914 Zeppelin	1,300
1918 L.70	8,200
10,000,000 cu. ft. rigid ...	18,000

These figures indicate clearly that, from the point of view of fuel consumption, the large airship is much more efficient than the aeroplane for carrying great loads at a moderate speed. It is possible, however, that this superiority may in practice be outweighed by the greater cost of upkeep of the airship, and, in particular, by the cost of the large housing sheds which are at present necessary, with their attendant need of a large *personnel* to handle the ships. The aeroplane will, of course, always be the better machine where small loads are to be carried at the highest possible speeds, and it is quite likely that a combination of aeroplane and airship services will often prove the best practical solution. For instance, as suggested in the paper under discussion, a rigid airship service might run between Lisbon and New York, passengers being taken to Lisbon from Paris, Rome, etc., by aeroplane. The aeroplane would thus compete with the express train, and the airship with the ocean liner, and a gain of not less than 50 per cent. in the time of transit would be realised in both cases.

In conclusion, the Air Ministry appears very optimistic as to the possibilities of the rigid airship in commerce, and produces excellent reasoning to support its optimism. One note of warning is sounded, and cannot be sounded too often, namely, that progress in point of size of aircraft must be made gradually. A premature attempt to build a very large aeroplane or airship is doomed to failure, and would do much to prejudice future development. If, however, progress is attempted in easy stages, giving time to overcome difficulties gradually, and to apply experience so gained to the next stage of development, there is every reason to hope that vast improvement will result in both aeroplanes and airships, and that the success of commercial aviation will be assured.

DR. F. DU CANE GODMAN, F.R.S.

THE death of Dr. Frederick Du Cane Godman on February 19 removes a familiar figure from the meetings of our scientific societies. Few men had greater opportunities of benefiting the science of their choice; none made a better use of them.

There is something characteristically British in the development of Godman's life-work out of the associations and friendships of his student days at the university. For it was at Cambridge in Godman's time and with Godman's help that the Ornithological Union and its journal, the *Ibis*, were founded, and at Cambridge that his fruitful friendship with Osbert Salvin was begun. Of that friendship, which closed with the death of Salvin in 1898, he wrote in his introduction to

the "Biologia Centrali-Americana": "The severance of a friendship such as ours had been for forty-four years was a terrible blow to me, for we were more intimately connected than most brothers, and, besides the personal loss, I missed his knowledge and experience in all things connected with our book. . . . It was with a heavy heart that I took up my pen again."

The choice of Central America as the field for their great enterprise was determined by an accident—the search for commercially profitable palm-nuts by Salvin in 1857—but no accident could have been more fortunate, for it hit upon the most interesting and exciting of all links between the tropics and the great northern land-belt. Prolonged isolation has led to the development, upon the great continent to the south, of a fauna unequalled in the world for combined peculiarity and richness. Then, in the fullness of time, the area supporting this teeming and varied population lost its isolation. What more exciting problem than a study of the intermediate tract which would show how far the southern forms have pushed to the north, the northern to the south? We know, as the result of this study, that the boundary between the two areas is concave towards the north, for the lower temperature of the high central Mexican plateau favours the northern forms, while the heat of the lower slopes and flats on the two coasts favours the southern.

It is unnecessary, on the present occasion, to speak in any detail of the sixty-three quarto volumes and 1677 plates in which this splendid contribution to zoology, botany, and anthropology is contained, for an admirable and yet brief statement of the history and scope of the work will be found in Godman's introduction, published in 1916. But a word must be said of the great band of naturalists who gathered round and assisted the two editors. Of this band, some, like H. W. Bates, Albert Günther, Joseph Hooker, O. Pickard-Cambridge, and P. L. Sclater, were veterans in 1879, when the first part appeared, and are now great memories. Others, again, found in the "Biologia" the whole of their training, and nearly the whole of their experience, as systematists. It is as Godman and Salvin would have wished, that their memories should always be bound up with those of the great body of experts who laboured with them.

Godman was the most modest of men. He found his reward in his love of the work he had undertaken, and looked neither for honours nor for recognition; but when they came the evidence of appreciation by his scientific comrades was a great pleasure and encouragement to him.

Outside his own subject Godman took a keen interest in all that concerned the advancement of science, and its neglect in this country was a real grief to him. He saw clearly the double importance of science for its own sake and for the sake of the intellectual training it gives. In these essential things he felt strongly that the country was being starved, and he feared for the future when he thought of our politicians and the way they had accepted their responsibilities in the past.

In failing health at the end of his long life, Godman's interest and sympathy remained unclouded, and in his dying hours he sent a last message to his colleagues giving his opinion on a much-debated subject about which he felt strongly. His last thoughts were with the great National Museum to which he had made so many noble contributions.

E. B. P.

NOTES.

THE following fifteen candidates were selected on Thursday last by the council of the Royal Society to be recommended for election into the society:—Prof. F. A. Bainbridge, Dr. G. Barger, Dr. S. Chapman, Sir C. F. Close, Dr. J. W. Evans, Sir Maurice Fitzmaurice, Dr. G. S. Graham-Smith, Mr. E. Heron-Allen, Dr. W. D. Matthew, Dr. C. G. Seligman, Prof. B. D. Steele, Major G. I. Taylor, Prof. G. N. Watson, Dr. J. C. Willis, and Prof. T. B. Wood.

SIR LAZARUS FLETCHER retired on March 3 from the directorship of the Natural History Museum after forty-one years in the service of the Trustees. Previous to his appointment as director on May 22, 1909, he had served two years as assistant and twenty-nine years as keeper in the Mineral Department. As keeper of minerals his first arduous task was to superintend the removal of the mineral collections from Bloomsbury to South Kensington, and to re-arrange them in the Natural History Museum. His next work was the preparation of those admirable guides, the introductions to the study of minerals, rocks, and meteorites respectively, and the selection and arrangement of series of specimens to illustrate them, which have earned him the gratitude of all students of the subject. "The Introduction to the Study of Minerals" is a highly successful attempt on the part of a great mathematician and chemist to surmount the difficulty of explaining a very technical subject without the aid of mathematics and chemical formulæ. In the intervals of this work, and later, Sir Lazarus Fletcher found time, in the chemical laboratory which had been fitted up in the museum, for his well-known researches on meteorites and minerals. After this exacting work as keeper of the Mineral Department, his tenure of office as director of the museum was still not devoid of care, for soon after his accession an attempted encroachment upon the grounds which had been allotted for the future expansion of the museum had to be repelled, and more recently during the war certain proposals which, if carried out, would have been disastrous to the collections had to be met.

A FEW weeks ago (January 23, p. 409) we referred to the approaching retirement of Sir Lazarus Fletcher from the directorship of the Natural History Museum, and the duty thus placed upon the Trustees of finding a successor who will maintain the high prestige of the museum among the corresponding institutions of the world From the letter which appears in our correspondence columns, signed by twenty-three naturalists of distinguished eminence, it appears that, as a temporary measure, the appointment of an administrative official to the post of director has been contemplated. We can scarcely believe that the Trustees will adopt such a course of action, which would be most derogatory to the position of science and the interests of the museum. The shortness of tenure, and the provision of an increased retiring

pension at the end, are merely matters of expediency, and are as nothing by the side of the principle and precedent involved. Scientific men should not for a moment accept the view that they are incapable of administration, or that the high posts which their knowledge qualifies them to fill can be occupied efficiently by administrators not possessing it. Skilled secretarial work, no doubt, facilitates communication between Government Departments, but it signifies routine and stagnation when it controls the activities of a scientific institution. Knowledge gives the driving power required for progressive development, and administrative functions should be subsidiary to it. Throughout the Civil Service there is already far too much of the reverse condition. We are glad, therefore, that a strong protest has been made against the assumption that the highest post open to naturalists in this country can be filled by an officer without the necessary scientific qualifications to do credit to it and the nation in the eyes of the world.

THE facts made known by Lord Gainford and Lord Harcourt in the House of Lords on February 26 show that a long time must elapse before our museums and the staff of the Board of Education can resume their work unhindered. The latter body is scattered throughout London, while its records are stored in the galleries of the Victoria and Albert Museum. Half that museum is closed to the public, its circulation department shut down, its textile classes and other aids to industry suspended. The priceless Wallace collections are still in underground tubes. The National Portrait Gallery, the London Museum, the Tate Gallery, and the British Museum galleries of prints and of Egyptian and Assyrian antiquities, as well as much of its storage space, are occupied by huge clerical staffs. Finally, the exhibition galleries of the Imperial Institute continue to be filled with a succession of other Departments; the institute's lectures and demonstrations are in abeyance, and its own research work is hampered because the raw materials are stored elsewhere. The result is not only to disappoint the American and Dominion troops, and to deny the British taxpayer the enjoyment of his great educational establishments; it is, above all, a serious check on the commercial and industrial development of the country. Unavoidable the delay may be, yet we cannot help feeling that the situation would not have arisen had Ministers a truer appreciation of the work done by and in our public museums.

THE KING has consented to act as patron of the British Scientific Products Exhibition, 1919, which will be held at the Central Hall, Westminster, during the month of July. The president of the exhibition is the Marquess of Crewe, and the vice-presidents include the Prime Minister and all the leading members of the Government. Prof. R. A. Gregory is chairman of the organising committee. The British Science Guild has been encouraged to organise this exhibition by the success which attended that held at King's College last summer and the more recent exhibition at Manchester. Now that many inventions can be shown which could not be put before the public during the war, there is every prospect that this year's exhibition will be even more successful than its predecessors. The objects of the exhibition will be to illustrate recent progress in British science and invention, and to help the establishment and development of new British industries. Such an exhibition will enable new appliances and devices to be displayed before a large public, and will provide progressive manufacturers with an opportunity of examining inventions likely to be of service to them, thus serving as a kind of clearing-house for inventors and manufacturers, as well as illustrating developments in science and industry. The exhibition will include sections dealing with chemistry, metallurgy, physics, agriculture and foods, mechanical and electrical engineering, education, paper, illustration and typography, medicine and surgery, fuels, aircraft, and textiles. Firms desirous of exhibiting are invited to communicate with the organising secretary, Mr. F. S. Spiers, 82 Victoria Street, London, S.W.1.

AT the forty-first annual general meeting of the Institute of Chemistry held on Monday, March 3, Sir Herbert Jackson, the president, referred to the work of the institute during the war. The record afforded an example of the value to the country of organised professional bodies in times of crisis. The institute is now co-operating with the Appointments Department of the Ministry of Labour in the resettlement in civil life of those who have been so engaged, and it is hoped that with the return of more normal conditions chemists will be utilised to the fullest advantage in the application of their science to the industries of the country. The president, in referring to the losses sustained by the profession, mentioned especially Lt.-Col. E. F. Harrison, who will always be remembered for his exceptional work in the provision of means of defence against poisonous gas attacks, in which work he undoubtedly sacrificed his life. The institute has before it a period of reconstruction, and will endeavour to bring together in one body the trained and competent chemists both for their own benefit and for that of the community. The events of the war have done much to establish the claim of chemists to greater recognition than has been accorded them in the past. The council has recently prepared a scheme of Government Chemical Service, which it is hoped will secure better conditions for chemists holding appointments under various Departments. The vital importance of chemical service to the State has been clearly demonstrated in recent years, and a good example set by the Government will go far to bring home to the public the importance of chemistry to industry and commerce. Sir Herbert Jackson was re-elected president of the institute for the ensuing year.

WHEN the Ministry of Health Bill passed its second reading in the House of Commons on February 26 Major Astor, Parliamentary Secretary to the Local Government Board, who replied on the debate, expressed gratification that a first-class measure had practically secured unanimous support from all parts of the House. From all accounts this is exactly what happened, and, apart from certain of the Welsh members, who desire to see separate provision made for the Principality, and some of the Irish members who do, and some who do not, wish to see the proposed Bill extended to Ireland, there were few voices raised in criticism. Clearly the majority had come to the second reading convinced that the Bill was the best likely to be obtained, and prepared to support it and accept all it proposed in the way of transference of powers, consultative councils, etc. Dr. Addison's advocacy, sound though it was, apparently was also quite dispassionate. His attitude suggested that he was addressing the members of a learned society and engaged in reading a paper upon a scientific subject. This impression was heightened by the fact that a large proportion of those who took part in the debate were medical men. These, led by Sir Watson Cheyne, devoted themselves largely to the question of research and the provision in clause 3 for placing this most important work in the hands of the Privy Council. It is interesting to note that, not only inside the House,

but also outside, and particularly amongst medical officers of health, whose society has issued a memorandum dealing with the Bill, medical opinion is strongly against any Department other than the Ministry of Health having control of research. In regard to the failure of the Bill to provide for the taking over by the Ministry of lunacy and mental deficiency there was comment also, and here again medical opinion is in favour of transference. As Dr. Addison pointed out, however, there was much detail that must be left to the future. The main and pressing business of the moment is to get the Ministry formed and to see that the definite fundamental health matters are brought within its purview. Other things will follow when the Ministry and the Minister have shown themselves worthy of the trust which everybody seems to be so willing to give them and of the high hopes that are based upon them.

CAPT. G. P. THOMSON will deliver his postponed lecture on "The Dynamics of Flying" at the Royal Institution on Monday next, March 10, at 3 o'clock.

THE death is announced, at eighty-five years of age, of Dr. Robert Liveing, consulting physician to the skin department of the Middlesex Hospital, and formerly lecturer on anatomy at Middlesex Hospital.

WE regret to announce the death on February 8, at ninety-four years of age, of Prof. J. J. T. Schlœsing, doyen of the section of rural economy of the Paris Academy of Sciences, and professor of agricultural chemistry in the Paris Conservatoire des Arts et Métiers.

Science for February 7 announces that Major C. E. Mendenhall, professor of physics in the University of Wisconsin, has been appointed scientific attaché to the United States Legation in London, and has been given leave of absence from the University to take up the duties of this post immediately.

AT the ordinary meeting of the Royal Society of Edinburgh, held on March 3, the following were elected ordinary fellows:—Dr. A. R. Cushny, Dr. W. J. Dundas, Dr. R. O. Morris, Dr. T. S. Patterson, Mr. B. D. Porritt, Mr. A. H. Roberts, Mr. W. A. Robertson, Dr. A. Scott, Dr. A. R. Scott, Mr. W. W. Smith, and Capt. D. A. Stevenson.

THE following lectures will be delivered at the Royal College of Physicians during March and April:—Milroy lectures, Half a Century of Smallpox and Vaccination, Dr. John C. McVail; Goulstonian lectures, The Spread of Bacterial Infection, Dr. W. W. C. Topley; Lumleian lectures, Cerebro-spinal Fever, Sir Humphry D. Rolleston.

THE Paris correspondent of the *Morning Post* announces the death, at sixty-eight years of age, of Prof. André Chantemesse, professor of hygiene in the faculty of medicine in Paris, member of the Academy of Medicine, and Inspector-General of Sanitary Services. Prof. Chantemesse was the author of works on typhoid fever, and others entitled "Moustiques et Fièvre Jaune," "Mouches et Choléra," and "Frontières et Prophylaxie."

AT a special general meeting of the British Psychological Society held in London on February 19 it was unanimously resolved that persons interested (instead of, as heretofore, engaged) in the various branches of psychology shall be eligible for membership. It was also decided to institute three special sections of the society, devoted respectively to the educational, industrial, and medical aspects of psychology. Further particulars may be obtained from the honorary secretary of the British Psychological Society, the Psychological Laboratory, University College, W.C.1.

IT is with regret we record that Capt. Melville Willis Campbell Hepworth, Marine Superintendent of the Meteorological Office, died at his residence at Ealing on February 25. Capt. Hepworth was in his seventieth year, and had held his official position since 1899. He was a Younger Brother of Trinity House, and received his C.B. in 1902 at the coronation of King Edward VII. The Monthly Meteorological Charts of the North Atlantic and Mediterranean, as well as of the East Indian seas, were initiated during his tenure of office, and the later editions of "The Barometer Manual for the Use of Seamen" and the "Seaman's Handbook of Meteorology" were compiled under his direction, and attained a large circulation. Capt. Hepworth was much interested in marine biology and in the temperature and salinity of the sea. Prior to his association with the Meteorological Office he was in command of mail steamers trading to the Cape and Australia, and later of vessels engaged on the Canadian-Australian steam route. For many years while at sea he made a study of meteorology which prepared him for his official position.

SIR ANDREW FRASER, K.C.S.I., whose death has recently been announced, was the son of a missionary and one of the many Scottish Presbyterians who have been distinguished members of the Indian Civil Service, and began his work in India in 1871. He served with distinction in the Central Provinces, and in 1903 was appointed Lieutenant-Governor of Bengal. He was in some ways unsuited for this difficult office, because he was unacquainted with the Bengali character, and was not qualified to deal with the organised resistance against the partition of the Provinces. While his policy of attempting to conciliate the revolutionary party, as is usual in India, served only to encourage anarchism, he met with courage at least five attempts against his life. Sir Andrew Fraser was a typical official of the secretariat type, and beyond his official duties his interests were limited, as is shown by the account of his experiences in his book "Among Indian Rajahs and Ryots," which, while interesting as a record of his official life, is lacking in first-hand knowledge of the ethnology, religions, customs, and manners of the races of India.

IT is reported from Ottawa that Mr. S. Storkerson, of the Canadian Arctic Expedition, with his party of five men, safely reached the Alaskan coast on November 19 last. When Mr. Stefansson was incapacitated by illness in December, 1917, and had to return to civilisation, his place was taken by Mr. Storkerson, who immediately made preparations for a journey from the coast of Alaska northward over the ice of the Beaufort Sea. He left Cross Island in about long. 146° W. on March 15, 1918, with a large party, including several Eskimo. When about two hundred miles north of the coast he sent back several of his men, and with the remainder continued his journey, expecting to be carried westward with the ice to the coast of Siberia. Practically no provisions were carried, the party relying on seal-meat and polar bears, as had been done in all the journeys of the Stefansson expedition. Contrary to expectations, based on the drift of the *Karluk* and other evidence, the ice did not move westward, but drifted around in a great eddy. The most northerly point reached was lat. 74° N., long. 152° W., in a part of the Arctic Ocean not previously explored. The problematical Keanan's

Land, which appeared in many maps in about lat. 74° N., long. 140° W., does not exist.

PROF. ANDREW MELVILLE PATERSON, who died after a brief illness on February 13 at the age of fifty-six, held a conspicuous place amongst modern British anatomists. Graduating in medicine at Edinburgh University in 1883, Prof. Paterson served his anatomical apprenticeship as a demonstrator in the dissecting-rooms of Edinburgh University under Sir Wm. Turner, and afterwards in Owens College, Manchester, under Prof. Morrison Watson. In 1888 he was invited to become the first occupant of the chair of human anatomy in University College, Dundee, and after labouring there for six years was elected to the Derby chair of anatomy in the University of Liverpool, a position which he occupied with distinction until his death. His intense public spirit led him to offer his services to the Medical Department of the War Office soon after the war commenced, and there is no doubt that his arduous duties as Assistant Inspector of Military Orthopædic Hospitals were accessory to his sudden and premature death. As an anatomist Prof. Paterson will be remembered for his contributions to our knowledge of the basal pattern in which nerves are distributed to the body, and particularly to the limbs, of vertebrate animals. That was the subject which first attracted his attention; his investigations led him on to an examination of the segmental character of the vertebrate body, particularly the variations which attend the segmentation of the sacral region. Most of his researches were published in the *Journal of Anatomy and Physiology*—now the *Journal of Anatomy*—but his monograph on "The Human Sacrum" appeared in the Transactions of the Royal Dublin Society (vol. v., 1893). In 1903, as a Hunterian professor at the Royal College of Surgeons of England, Prof. Paterson gave a series of lectures on "The Morphology of the Sternum," which was published in book form in the following year. In these lectures he maintained that the sternum must be regarded as a derivative, not of the ribs, but of the shoulder-girdle. He was also the author of several brochures on anatomy and embryology, as well as a contributor to standard text-books on human anatomy. Some of the essays which he printed for private circulation were pieces of real literature.

MR. E. H. STENNING, King William's College, Isle of Man, sends a description of a brilliant auroral display seen there on February 27. The luminous areas appeared at about 8.30 p.m., and increased in intensity until 10.10 p.m. They took the form of two large parallel arcs, extending across the northern sky. The brighter of the two bands, the inner, was so bright that no star appeared to shine through it. It was separated from the outer arc by a broad black band. The inner band seemed to be of fixed intensity, but the outer varied incessantly. In altitude the highest portion of the outer band was well above the central star of Cassiopeia, and the brightest portion of the band was about 4° below the lower stars of this constellation (10.10 p.m.). The luminosity of the outer band faded rapidly, beginning from the ends, and at 10.45 could not be seen. The inner band was still visible, though faintly, at 11.15.

INFLUENZA has again further increased in severity over the British Isles, and the Registrar-General's return for the week ending February 22 shows that the deaths in London and in the ninety-six great towns of England and Wales were more than double those of the preceding week. In London (county) the deaths from influenza were 653, which is greater than in any week since that ending December 7, and the deaths in the ninety-six great towns were 3046. The deaths from influenza in London had risen from 13 per cent. of the deaths from all causes in the preceding week to 25 per cent. in the week ending February 22. The deaths are still highest at the ages from twenty to forty-five, being 44 per cent. of the total, and there is some increase in the percentage of deaths above sixty-five years. Out of 12,939 deaths in London from influenza during the last twenty weeks there have been 5987 deaths at the ages twenty to forty-five, which is 46 per cent. of the total deaths from the epidemic. At the ages up to five years there were 12 per cent. of the total deaths, at five to twenty years 16 per cent., at forty-five to sixty-five years 17 per cent., at sixty-five to seventy-five years 6 per cent., and above seventy-five years only 3 per cent.

MR. J. REID MOIR describes in the February issue of *Man* a remarkable piece of carved chalk recently found by the Hon. R. Gathorne-Hardy in his park at Great Glemham House, Saxmundham, Suffolk. The specimen, measuring $4\frac{1}{2}$ in. by $2\frac{3}{4}$ in. by $2\frac{3}{8}$ in., is of a dull white colour, and has sandy material embedded in the interstices. It is believed that it was brought to the surface by the action of rabbits, the burrows of which are very numerous at Great Glemham. Mr. Moir believes that, in its outline, the piece of chalk bears a very close resemblance to the outline of the mammoth (*E. primigenesis*), with which the scientific world has become familiar by an examination of carcasses of this animal found in the frozen ground of Siberia, and by drawings and outlines upon bone and other materials discovered in the Aurignacian and later Palæolithic deposits in France and elsewhere. The specimen certainly exhibits many remarkable points of resemblance to the mammoth, but the question remains whether these resemblances may not be accidental or the result of weathering. It may be advisable to await further examination by experts before we express a decided opinion upon this remarkable discovery.

WE have received a copy of the first issue of the *Balkan Review*, which is to be published monthly by the Rolls House Publishing Co. at the price of 1*s.* 3*d.* The editor is Mr. Crawford Price. The review aspires to cultivate financial and commercial relations between Britain and the Balkans, and to act as an organ of *liaison* between the West and the East. Its scope covers social, political, historical, and geographical aspects of Balkan lands. "While supporting the existing *entente* between Greece, Serbia, and Rumania, we shall hold the door ever open for the admission of a regenerated and reformed Bulgaria." The first number contains several interesting articles, including one on the Jugo-Slavs and another on the group of islands known as the Dodecanese.

THOUGH for skeletonising purposes the use of the tryptic digestion process has long been known, the method does not appear to have been much used in England. Miss Kathleen F. Lander directs attention to its great value in the *Museums Journal* for February. She finds that half a gram of trypsin in a litre of water makes the best solution, and to this is added a pinch of sodium bicarbonate to ensure alkalinity. If allowed to digest at a temperature of 37° C., the preparation of a skeleton can generally be completed within twenty-four hours. The method is superior to maceration in warm water only in so far as rapidity of action is concerned, and it is certainly costly. Trypsin—sold by Messrs. Burroughs and Wellcome—costs 50*s.* per ounce, and the solu-

tion, when ready for use, 1s. per litre. Fortunately, however, it retains its digestive action for a fortnight before the ferment is destroyed by bacteria, but its action becomes slower and slower.

IN the *Gardeners' Chronicle* of February 8 Mr. W. B. Brierley, writing from the recently established Institution of Pathological Research, Rothamsted, discusses the question of the diseased areas on orchid-leaves known to horticulturists as "orchid spot." This, he points out, is not a single and specific disease, but a congeries of diseases, all little understood and urgently in need of detailed investigation. From the casual examination of diseased specimens during the past two or three years Mr. Brierley has recognised seven distinct types of disease. Of these it is highly probable that four are the result of the action of parasitic organisms, one of local chilling of the leaf-tissues, one probably of atmospheric poisoning, and one of some other physiological derangement of the protoplasm, due probably to unsuitable cultural conditions in the plant's physical environment. A continuous and intensive study of "orchid spot" would doubtless show that the seven diseases are but a few of the many covered by this name. At present all these diseases are lumped together as "orchid spot," and horticulturists endeavour to control a disease of physical causation by a fungicidal spray, or a fungal epidemic by regulating to a nicety the temperature of the water supply. There is needed a detailed investigation of this group of diseases, a critical experimental study of the physiological relations of the plants to their environment, an understanding of all the complex hygienic factors involved, and a thorough elucidation of the life-histories and biological relations of the pathogenic organisms which may be present. Only on such a foundation can a rational scheme of prophylactic and therapeutic treatment be based.

THE Monthly Meteorological Chart of the East Indian Seas for February, issued by the Meteorological Office, shows in great detail the various meteorological data. Winds are given in an extremely intelligible and useful form for navigators, and aircraft can use much which has been primarily prepared for the seaman. The wind-zones show for each 5° of latitude by 5° of longitude both frequency and strength. The limits of the trades and monsoons are shown on the face of the chart, and tracks of some cyclonic storms are given. Results for the several elements are obtained from records extending over a period of about sixty years. Ice information is given on the back of the chart, and navigators voyaging in high southern latitudes will find the information very helpful in avoiding a common source of danger. There is a desire on the part of the Meteorological Office for captains who are interested in meteorology to assist in the work by observing for the Office. Naturally, the organisation has been seriously interrupted by the war, so that the assistance of voluntary observers is now the more urgent. The series of charts for the several months shows in the clearest possible manner the change of monsoon over the area of the sea embraced.

OUR ASTRONOMICAL COLUMN.

THE ORDER OF THE PLANETS.—In the oldest cuneiform inscriptions the planets are given in the order Jupiter, Venus, Saturn, Mercury, Mars (*vide* "Encycl. Brit.," eleventh edition, vol. ii., p. 796, "Astrology"). Dr. Herbert Chatley writes from Shanghai to point out that if we calculate the total gravitational force between the sun and each planet (viz. product of masses ÷ square of distance) we obtain results which in order of magnitude agree with the list above. With the latest values of the planetary masses the numbers are:—

Mercury, 0·24.	Mars, 0·05.
Venus, 1·58.	Jupiter, 11·76.
(Earth, 1·00.)	Saturn, 1·04.

This cannot be anything more than a coincidence, but it is sufficiently curious to justify mention. Dr. Chatley notes that if by chance the ancients had possessed the necessary knowledge, they would have grouped the planets, not by the simple attractions, but by their tide-raising power, which would have involved the inverse cubes of the distances.

CEPHEID VARIABLES.—The *Observatory* for February contains a letter by Mr. J. H. Jeans on the Cepheid problem. Mr. Jeans gives the following functional formula for the Cepheid light variation:—

$$a \cos nt + bf[n(t-\eta)],$$

where a, b, η are adjustable constants, and f is the same function for all stars. The spectral type follows the second term of the expression fairly closely, maximum value of f corresponding with early or B type, minimum value with late or K type.

The graph of the function f shows a steep rise followed by a much less steep and approximately exponential descent; its period is the same as that of the first term in the formula. This latter fact leads the author to the conjecture that the $a \cos nt$ term arises from the rotation of a single elongated body, and the bf term from an explosion which occurs in a particular orientation of the body, this explosion producing the change in spectral type. He shows that Mr. Phillips's Group I. of light-curves would be explained by one explosion per rotation, and Group II. by two explosions per rotation. There is, however, a difficulty in picturing a mechanism that could produce explosions in fixed orientations, for any external disturbing body would necessarily be changing its orientation.

VARIATION OF LATITUDE.—The observatories of Mizusawa, Carloforte, and Ukiah (all in N. lat. 39° 8′) continued their series of latitude observations throughout 1917. The results are discussed by B. Wanach in *Ast. Nach.*, No. 4969. The minimum latitude in the meridian of Greenwich was −0·14″ at the end of March, the maximum +0·16″ early in November. The track of the pole is considerably more contracted than in the two preceding periods.

Issei Yamamoto contributes a paper on the "Kimura" or "z" term in the latitude variation (Proc. Tokyo Math. Phys. Soc., second series, vol. ix., No. 17). He has made observations to test Prof. Shinjo's suggestion that the term arose from an annual term in the distribution of temperature in and above the observing-room, and consequent dissymmetry in the refraction.

He made a specially designed observing-room, with precautions to equalise the temperature of the air above it, and found that the "z" term was greatly reduced. His results thus tend to confirm Shinjo's suggestion.

The values of the variation of latitude that are adopted for the Greenwich reductions are deduced from the results obtained with the Cookson floating telescope. They are ready long before the publication of the results at the international stations, and it is found that they do not differ much from the latter.

THE HEALTH OF OUR CHILDREN.[1]

ONE feels on reading the report referred to below that the nation possesses in Sir George Newman a general with a plan, who, having consolidated the gains of ten years' work, is pressing on to his objective: the prevention of disabling diseases and the winning for every child of his birthright of a happy and healthy childhood. Such is the impression gained by a careful study of this most interesting and comprehensive report.

In section iii. will be found the results of a typical medical inspection conducted by a most competent observer—Dr. C. J. Thomas, of the London County Council. Two sets of three hundred unselected elder children each, in typical London and country schools, were inspected, and the results are described and analysed. One reads with dismay that "after deduction of the blind, deaf, mentally and physically defective, and invalid children drafted to special schools or absent from school, there were of the children present at school 21 per cent. found to be suffering from one or more serious defects . . . 12 per cent. were ill-nourished; 19 per cent. were unclean in body; of the London children 40 per cent., and of the country children 65 per cent., had some carious teeth; 11 per cent. suffered from disease of nose or throat; 10 per cent. had 'very serious' defects of vision; 6 per cent. suffered from defective hearing and 6 per cent. from severe anæmia; and of middle ear disease, of organic heart disease, of skin disease, and of spinal curvature of 'worst grade' there were in each case 4 per cent. of sufferers."

We agree with Sir George Newman's comment on these grim facts:—"No one, I think, can consider these findings or read Dr. Thomas's account of the physical condition of these children about to leave school for industrial occupations without understanding, once and for all, the gravity of the situation."

It is with a sense of relief one finds that a good deal is being done by several education authorities to remedy the defects found. There are still, however, a good many C3 authorities. Most hopeful of all, however, is the policy "broad and deep" which the Board of Education's Chief Medical Officer, since translated to the Local Government Board, has all along had in mind—the safeguarding of each and every child's health from babyhood up to and including school-life. This policy we find explained in his excellent exposition of those sections of the new Education Act which deal with the health of children and young persons.

"The Act," writes Sir George, "lays emphasis upon the broad fact that the purposes of the School Medical Service are not the detection of defects, the discovery of child-patients, and the treatment of such sick children, *but the advancement of the health and physical development of the whole child population of school age.*"

The author of this report does not rest content with a recital of first principles. He points the way to their realisation. Thus we find much practical advice on the teaching of hygiene and mothercraft, on the control of juvenile employment, on open-air schools, on physical education, on play-centres, and on holiday camps. We note with pleasure his reference to the cheery brotherhood of Boy Scouts.

Everyone interested in education, and therefore in our children, should study this inspiring report. Certainly the *personnel* of the School Medical Service must realise that they have had as chief, not only an eminent expert, but also a man of large vision, a leader who really leads. W. E. H.

[1] Annual Report for 1917 of the Chief Medical Officer of the Board of Education. (Cd. 9206.) (H.M. Stationery Office.) Price 1s. net.

FORTHCOMING BOOKS OF SCIENCE.

BIOLOGY.

Ginn and Co. (*Boston, Mass., and London*).—An Elementary Biology, Gruenberg; Manual to Elementary Biology, Gruenberg. *Oxford University Press.*—Mammalian Physiology: A Course of Practical Exercises, Prof. C. S. Sherrington. *John Wiley and Sons, Inc.* (*New York*), *and Chapman and Hall, Ltd.*—Economic Woods of the United States, Prof. S. J. Record; Forest Management, A. B. Recknagel and J. Bently, jun.; Bacteriology and Mycology of Foods, Dr. F. W. Tanner, illustrated.

CHEMISTRY.

Ginn and Co. (*Boston, Mass., and London*).—Notes on Qualitative Analysis, Test and McLaughlin. *John Wiley and Sons, Inc.* (*New York*), *and Chapman and Hall, Ltd.*—Commercial Oils, I. F. Lauchs; Manual of the Chemical Analysis of Rocks, Dr. H. S. Washington.

ENGINEERING.

Benn Bros., Ltd.—Electrical Measuring Instruments: Their Design, Construction, and Application, Dr. C. V. Drysdale and A. C. Jolley; Electric Traction on Railways, P. Dawson, illustrated; The Handling of Materials: A Manual on the Design, Construction, and Application of Cranes, Conveyors, Hoists, and Elevators, being the second edition of Electric Cranes and Hoists, H. H. Broughton, in four volumes, vol. i.; The "Electrician" Annual Tables of British and Foreign Electricity Undertakings; and new editions of Electric Mains and Distributing Systems, J. R. Dick and F. Fernie, and Electric Switch and Controlling Gear, Dr. C. C. Garrard. *Sir Isaac Pitman and Sons, Ltd.*—Electric Mining Machinery, S. F. Walker, containing chapters on prime-movers, signalling, telephony, shot-firing, etc.; Reinforced Concrete, W. N. Twelvetrees, dealing with the subject from the theoretical and practical points of view; Gas and Oil Engine Operation, J. O'Kill; Papers on the Design of Alternating-current Machinery, C. C. Hawkins, Dr. S. P. Smith, and S. Neville; Storage Battery Practice, R. Rankin; Electrical Engineers' Pocket-Book, edited by R. E. Neale, being a thoroughly revised edition of the volume originated and edited by K. Edgcumbe. *John Wiley and Sons, Inc.* (*New York*), *and Chapman and Hall, Ltd.*—Waterproofing Engineering: For Engineers, Architects, Builders, Roofers, and Waterproofers, J. Ross; Geodesy and Geodetic Surveying, Prof. G. L. Hosmer; Principles of Transformer Design, Prof. A. Still; Oxy-Acetylene Welding Manual, Lieut. L. Campbell, jun.; Essentials of Alternating-current Electricity, W. H. Timbie and Prof. H. H. Higbie; Vital Statistics, Prof. G. C. Whipple; and new editions of Irrigation Engineering, Dr. A. P. Davis and H. M. Wilson; Compressed Air Plant: The Production, Transmission, and Use of Compressed Air, with special reference to Mine Service, Prof. R. Peele.

MATHEMATICAL AND PHYSICAL SCIENCES.

Ginn and Co. (*Boston, Mass., and London*).—Advanced Book of Arithmetic, Wentworth and Smith; General Mathematics, First Year, Schooling and Reeve; Projective Geometry, Wentworth, Smith, and Ling; Plane Analytic Geometry, Wentworth, Smith, and Siceloff; and a revised edition of Elements of Astronomy, Young. *John Wiley and Sons, Inc.* (*New York*), *and Chapman and Hall, Ltd.*—The Sumner Line, or Line of Position as an Aid to Navigation, Prof. G. C. Comstock.

TECHNOLOGY.

Sir Isaac Pitman and Sons, Ltd.—Petroleum, A. Lidgett; Salt, A. F. Calvert; Coal-Tar, A. R.

Warnes (Common Commodities and Industries Series). —*John Wiley and Sons, Inc. (New York), and Chapman and Hall, Ltd.*—Mechanical Drawing, J. S. Reid.

MISCELLANEOUS.

Oxford University Press.—The Bantu and the Semi-Bantu Languages: A Comparative Study, Sir Harry H. Johnston; Slavic Europe: A Selected Bibliography in the Western European Languages, R. J. Kerner; World Power and Revolution, E. Huntington; Some South Indian Villages, by a number of Indian Students, the first volume of Economic Studies, edited by Prof. G. Slater, illustrated.

METEOROLOGY DURING AND AFTER THE WAR.[1]

DURING the past four years and a half of hostilities meteorology has, like many other branches of knowledge, been utilised in naval and military operations to a far greater extent than ever before. Consequently, there are now a large number of officers in the Services who have had practical experience of the value of meteorological information when it has been prepared from sufficient data, and by men who have been thoroughly trained in the subject. It is, therefore, highly desirable that full advantage should be taken of the experience which has been gained during the war in order to meet, as adequately as possible, those demands which will be made upon meteorology in the general reconstruction which is now beginning.

In some ways the conditions which prevailed during hostilities were favourable to advances in the subject. Special facilities were given for the rapid transmission of reports; kite-balloons could furnish series of observations at various heights; aeroplanes were available to observe the temperature in successive layers of the atmosphere up to 12,000 ft. or 14,000 ft.; the velocity and direction of air-currents up to even 25,000 ft. were determined by the bursting of shells fired at high angles; pilot-balloons at perhaps a hundred stations were observed four or more times daily. In these and other ways a vast store of information has been amassed which has already been utilised, but remains available for much more detailed study in the immediate future; and not the least difficult problem will be to reduce the mass of information to a manageable and orderly arrangement.

There were in 1914 in this country the State Meteorological Service (the Meteorological Office) and a Naval Meteorological Service, which had been formed in 1913 to meet the needs of the Royal Naval Air Service. Besides these, a private institution, the British Rainfall Organisation, collected and discussed observations of the rainfall of the British Isles and studied all questions connected with rainfall; also two scientific societies—the Royal Meteorological Society and the Scottish Meteorological Society—specially devoted themselves to the advancement of meteorological science. It will be seen, therefore, that only the State service could provide a career for anyone desiring to take up meteorology as a profession, and as the staff of this service was comparatively small, it is scarcely surprising that the great majority of meteorologists were amateurs in the sense that they studied the subject from their interest in it, outside their ordinary occupations.

In the Meteorological Office the policy for some years had been to bring in men who had had a thorough scientific education at a university and to encourage them to devote it to the study of the many problems which meteorology had to offer. This was a great advance from the empirical treatment of the subject, and has been amply justified by the success obtained when this policy has been tested under the conditions of active service.

For the general public current meteorology was mainly represented by the daily forecasts and the weather summaries which appeared in the Press, and the cases in which these failed to describe accurately the weather in the reader's immediate locality usually impressed him more than their general accuracy as tersely worded descriptions of conditions which were likely to prevail over an extended area, such as south-eastern England, but those who had only been brought into contact with meteorology in this superficial way on the outbreak of hostilities soon found that the weather affected their preparations and their operations at every turn. It was scarcely to be expected in these circumstances that all Staff officers would at once realise what information trained meteorologists could provide, or to what extent their reports and warnings could be relied upon in practice.

In the course of the last two decades investigations have been extended from the surface of the earth into the air by means of kites and balloons, and our knowledge of the conditions prevailing up to ten, and even fifteen, miles above the earth's surface has thereby been steadily increased. Self-recording instruments continuously registering the pressure, temperature, and humidity have been carried up through the lower seven miles (11 kilometres), the troposphere—the region in which the temperature falls with increasing height—and far into the stratosphere above it, sometimes to heights of 12½ miles (20 kilometres) or more. In this way the remarkable fact of the differentiation of the atmosphere into the lower troposphere and the overlying stratosphere has been established, and further investigations indicate the great importance of these upper regions of the atmosphere in the solution of many problems relating to the weather.

With the gradual introduction of balloons and aircraft into the Army, and the subsequent formation of the Royal Flying Corps, meteorological establishments were formed at South Farnborough in 1910 and at Upavon in 1913, where the study of the upper air was carried on regularly. In this way, and with the material furnished by the meteorologists of other countries, a very large amount of information had been collected, and, to a large extent, discussed and utilised, before the outbreak of war, but this was, for the most part, known and appreciated only by those who were especially interested in the subject, and the bearing of the results obtained had not reached the wide circle of those who were later to become acquainted with them under the exacting conditions of active service.

On the outbreak of hostilities some lines of work had to be abandoned, and new lines taken up at once. Many of the staff of the State service joined the Army in those early days who would have been very profitably employed in the meteorological units which were formed later, or even in the Office itself, where the work became ever increasingly heavy, while the task of replacing those who went on service became constantly more difficult.

On the outbreak of war in August, 1914, meteorologists were at first considerably handicapped by the reduction of their supply of information. Wireless reports from ships ceased; weather telegrams from Germany and Austria were no longer available; and Central Europe became a blank on the working charts of the Meteorological Office. The censorship over all inward and outward telegrams disorganised the supply of meteorological information from Allied and neutral

[1] From a paper read before the Royal Society of Arts on January 22 by Col. H. G. Lyons, F.R.S., Acting Director of the Meteorological Office.

countries for a while, but this was soon rectified, and daily weather reports could again be prepared, though lacking part of the Continental information. As time went on the need for more and more distant stations was felt, and by 1916 reports were being regularly received from Spitsbergen to the North African coast and Cairo, and from Iceland and the Azores to the Russian stations of Petrograd, Nicholaieff, Sebastopol, and Batum.

The supply of daily weather reports and forecasts to the public was stopped, but their preparation was continued actively in the Meteorological Office, where the telegraphic reports which were collected several times daily reached the number of about one hundred, and the information which they contained was compiled on working charts from which the forecasts were prepared. These were issued to the Admiralty, to various dockyards, to the Grand Fleet, various battle squadrons, submarine flotillas, etc., each of which required reports and forecasts adapted to their special needs. Similarly information was supplied to the Naval Meteorological Service for the Royal Naval Air Service, and to numerous units of the Royal Flying Corps, or the Royal Air Force as it afterwards became.

To provide information for aviators in the early morning or for use in preparing plans for the day's operations, it became necessary to take observations in the early hours of the morning, and 3 a.m. was the hour chosen at first, but this was not found to be early enough, and 1 a.m. was finally adopted, making the observing hours 1 a.m., 7 a.m., 1 p.m., and 6 p.m. Thus a continuous twenty-four-hour forecasting service was established, and has been maintained in operation up to the present time, to prepare forecasts and reports four times daily; and to telegraph the observations taken at selected stations to the Meteorological Section at the British General Headquarters in France, and to other stations that required them, as well as to the Meteorological Service of the French Army, and later to that of the American Expeditionary Force.

Under service conditions something simpler, plainer, and more direct in its presentation of the opinions of the trained meteorologist who prepared it than the ordinary daily weather report with its statistical data was needed. Those who had to make use of the daily weather reports were usually far too busy to wish to study the statistical material before accepting the meteorological opinions which were offered to them. They wanted a direct statement of expert opinion which they could make use of in preparing their own plans of action. The desire for such expert assistance was also shown by many requests that forecasts should be expressed in "perfectly simple and non-technical language." To this very reasonable request it is not so easy to accede as it may seem. Such expressions as "a depression advancing from the westward," "a secondary depression developing over the Channel," "an anticyclone spreading northward," are more than mere statements of fact; they convey to all who are acquainted with meteorology much additional information depending on the weather conditions described, which it would take several paragraphs to state simply and in non-technical language.

So far as meteorological conditions could be set out in plain language, this was done in these special daily weather reports, which were issued in the early morning, before noon, and in the afternoon to all who required them; and these were supplemented by special summaries, one of which dealt with the prevailing and the prospective weather conditions on all fronts where military operations were in progress, and another with the weather conditions in the various sea areas round Europe.

The whole of this information was of a highly confidential character, since Germany and Austria were cut off from all weather reports from meteorological stations to the westward, except those of neutral countries, Norway and Spain.

We shall doubtless learn eventually to what extent the precautions taken sufficed to prevent information about the weather conditions over the British Isles and to the westward reaching the Central Empires, but at the time we had to depend mainly on negative evidence. It was not difficult to estimate from the working weather-chart what sort of forecast the enemy meteorologists would probably make on the assumption that the information from a wide area to the westward of them was not available, and this was done daily as part of the routine of the Meteorological Office. In the case of attacks by enemy aircraft it was fair to assume that his meteorological service considered the conditions to be reasonably favourable; and this was compared with the estimate of his opinion which had been formed here. Occasionally enemy forecasts were available, and these were compared in the same way. Negative evidence is not conclusive, but the impression that we gained was that little, if any, meteorological information of value was obtained from our area.

Many cases could be cited where operations were undertaken by the enemy which it seemed very unlikely that he would have undertaken had he possessed the information which we had here.

By the spring of 1915 two branches of the Army, the Royal Flying Corps and the Special Brigade, R.E. (Chemical Warfare), had decided that they required the co-operation of trained meteorologists who could explain the meaning and the limits of the forecast, answer questions or give advice, and arrange for fuller or more suitable information being furnished when required.

These demands for the provision of trained meteorologists in France led to the formation of a meteorological section as a unit of the Corps of Royal Engineers which had at first a strength of about four officers and twenty non-commissioned officers, but the establishment was repeatedly increased until, when hostilities ceased, it consisted of thirty-two officers and about two hundred other ranks, and provided sections for duty, not only in France, but also on the Italian and Macedonian fronts, besides a reserve section at home. From a small unit at General Headquarters in France the organisation developed until there was a meteorological unit with each army and one with the Independent Force, R.A.F., these units having their groups of observers and pilot-balloon stations reporting to them. The telegraphic weather reports from the stations in the British Isles, as well as those received from a large number of European stations, were at first thrice daily, and later four times daily, telegraphed from the Meteorological Office in London to the Meteorological Section at General Headquarters in France, in order that weather-maps might be drawn and forecasts prepared there as might be required. This information was supplemented by data which the Meteorological Section collected from its station on the British front, and also from other parts of France through the French Meteorological Services.

In this way on the Western front, and similarly at later dates on the Italian and Macedonian fronts, a network of meteorological stations was built up, which, with the addition of the data and reports furnished by the Meteorological Office, enabled the meteorological officers to supply the information which the different Services required for their special purposes, to issue forecasts and weather warnings, and also, as will be seen later, to increase very materially the accuracy of the work of some of the Services.

The task of providing the *personnel* for this military unit was no easy one, for, as has been already men-

tioned, the staff of the Meteorological Office was small, and outside it there were very few expert meteorologists who were available. At first three of the senior staff of the Meteorological Office received commissions for duty in France, and afterwards a number of men who had a thoroughly scientific education at a university joined the Meteorological Office for longer or shorter periods of training before being posted to the Meteorological Section, and in this way a high-grade scientific staff was formed and maintained. To a training which included especially mathematics and physics was added as much instruction and practice in advanced meteorology as could be given in the time available, and on the basis of such an education the meteorological aspect of the problems was quickly appreciated.

As time went on the scope and number of such reports and warnings steadily increased until there was a regular and continuous flow of information sent out from meteorological offices to various branches of the Service for them to utilise as best fitted the operations in hand. The Royal Air Force required forecasts of weather for short periods which it could use for its reconnoitring and bombing squadrons; for day operations reports of the wind direction and velocity obtained from pilot-balloon ascents and high-angle shell-bursts were communicated from different altitudes up to 20,000 ft.; for night operations information for lower levels sufficed, and the arrangements had to be modified. For high altitudes a central station could supply information adequately, but when data concerning lower levels became important, where the air turbulence set up by friction with the earth's surface became a material factor, the reports were more effectively supplied by local stations where the special conditions could be more effectively studied. For all this the most rapid means of transmission is essential; for the shorter the forecast period, and the more detailed the forecast in its information, the more rapidly must it be placed at the disposal of the aviator if it is not to mislead him. These reports were largely supplemented by telephone inquiries by those interested, and a precision was demanded which was often very difficult, and sometimes impossible, to attain. Success in answering these inquiries is reached by having as meteorological officers men who have an acquaintance with the physical condition of the region, and also possess such a scientific training that they instinctively proceed from cause to effect, and facts at once fall into their place in their minds. This is very different from the acquired skill of an empirical forecaster, who can never attain the same confidence in his opinion. The work of a meteorological officer who has to advise on the suitability of conditions for long flights, especially on active service, is very responsible, and throws a great strain on him, since he cannot but feel that on his advice great risks may be taken and grave danger encountered. In regions where high plateaux exist near the sea-coast, as in Macedonia, the cold-air currents which stream downwards, by reason of their greater density, to lower levels often attain full-gale velocity, blowing in violent gusts, and constitute an element of serious danger to aviators. The conditions which favour such a phenomenon are known and recognisable, but it may be very difficult to say precisely whether or not the descent of cold air will take this violent form.

In chemical warfare a different set of problems was encountered. Here we are concerned with the movement of air-currents close to the surface of the ground, affected by all its irregularities, diverted this way and that by obstacles, and generally in that state of irregular motion known as turbulence in which eddies form, break up, and re-form, greatly complicating the conditions. At night, too, when the surface wind may die down to a calm and the ground cools under a clear sky, the colder and heavier air streams down from higher ridges into valleys and low ground. Consequently the direction and velocity of air-currents along the front had constantly to be observed and studied in relation to the relief and conditions of each section; so long as the wind was favourable for enemy operations, or even likely to shift into a favourable quarter, observations, reports, and warnings were unceasingly needed.

But, besides the aviators, there are other branches which are vitally interested in the conditions which prevail in the upper air. Projectiles leave the firing-point and traverse a considerable thickness of the atmosphere during their flight, reaching an altitude of about 10,000 ft. for a fifty-second trajectory. In its passage through the air a projectile traverses strata of different temperatures, and consequently of various densities, so that a correction has to be applied to the range-tables. On a winter day, when the temperature at the surface is 3° F., the temperature at 3000 ft., 6000 ft., and 9000 ft. may be 15° F., 16° F., and 12° F. respectively, so that any correction based on the temperature near the ground would be wrong. Also the wind varies considerably, and often irregularly, both in velocity and direction as the ground is left, so that a correction based on mean conditions here will probably be widely different from that which should be used on any particular occasion.

These considerations led to a much wider application of meteorological information to the practical correction of gunnery than had hitherto been employed, and reports of upper-air temperature and of the velocity and direction of the wind at various altitudes were regularly prepared and transmitted from meteorological stations along the various fronts. This increased application of meteorology to ballistics raises many problems of interest and importance, which demand for their solution the co-operation of scientific gunnery and meteorological science of the highest order.

To mention another field, the sound-waves which are recorded in sound-ranging, that wonderful adaptation of the physical instruments of the laboratory to practical use on the field of battle, traverse the lower layers of the atmosphere, and as higher and higher accuracy was aimed at, it became clear that meteorological observation must be made concurrently, and utilised in order to attain the desired precision.

Frequent mention was made during the war of the meteorological efficiency of the enemy's organisation and of the very favourable conditions which he experienced during many of his operations; his superiority in these directions was not infrequently assumed. It is not possible to compare the effectiveness and success of the rival organisations until much more information is available and, in the discussion and investigation of past operations, the various contributing factors have been sorted out and duly weighed. No doubt Germany started with a much larger number of men who had received a scientific training in the subject, for professors of meteorology existed at several universities; the appreciation of the subject and its practical value, too, may have been more general among that nation; but, as a personal opinion, I do not believe that it attained a higher standard than our own. Many apparently did not realise that the occurrence of bad weather during operations did not necessarily mean that the commander and his staff had no information regarding the impending weather changes; but weather is only one of many factors which have to be taken into consideration, and it must often be

that operations planned and prepared must be carried out whatever the weather may be, though a good forecast may at the last moment enable him to judge whether nearer or more distant objectives are likely to be attained.

Free discussions and conjectures on the subject of the enemy's advantages and the necessity for maintaining a strict silence regarding the details of our organisation naturally led many to doubt whether adequate steps had been taken to utilise meteorology to the full. Many offered their services as forecasters of experience, or as having methods which they considered could give highly trustworthy results, but they did not realise that much more was needed than a brief description of general weather conditions. They did not know that a large and somewhat intricate organisation had been found necessary, in which each man played his appointed part, and from the combined results of whose labours the required information was evolved.

There are now four State meteorological services in operation—the Meteorological Office, the Admiralty Meteorological Service, the Meteorological Section, R.E., for the Army, and the Meteorological Service, R.A.F., of the Air Ministry—and the relations and the means for co-operation between these four services will have to be worked out, and a number of considerations taken into account.

So far as the study of the weather and the issue of forecasts is concerned, short-period meteorology, as it may be called—rapidity of transmission of the observations to the Central Office, where they are discussed and compared, and of the forecasts, warnings, etc., which are sent from it—is the first essential, and the needs of aviation have only accentuated this. Observations should be in the Central Office for the forecaster's use not later than one hour after they are taken if he is to get out his reports and warnings early enough to be of effective use to aviators. This will mean a considerable acceleration in the collection and transmission of reports from some parts, for a country's own reports are not enough; those from selected stations in the surrounding countries are needed in order to form a correct view of the changes that are taking place. Wireless telegraphy will assist in meeting such requirements, and each country will soon, it is hoped, send out the meteorological observations taken at some ten to fifteen of its selected stations four times daily at fixed hours. French observations are already being sent out thrice daily from the Eiffel Tower in this manner, but some organisation will be necessary to bring this into operation as a general practice. With foreign reports collected in this way, and special priority for the necessary number of inland reports, forecasts could be got out more quickly, and, consequently, be of far greater utility.

Only a small proportion of the observations which are taken can ever be printed and published, so all working meteorologists must often refer to the voluminous collection of manuscript data which every meteorological service accumulates. Where research into the problems of the atmosphere is to be actively carried on there must be free access to such a collection, as well as to a well-stocked library on the subject.

All these considerations indicate the desirability of a close contact and co-operation between all the meteorological services in a country, so that the whole material may be available to each, that the scientific staff of each may be able to discuss the points which may arise, and that information may be quickly and easily distributed.

Aviation, with its prospect of long-distance communication, has rendered necessary a readjustment of meteorological relations within the Empire. Canada, South Africa, Australia, New Zealand, India, and Egypt and the Sudan have all their well-equipped meteorological services, which include networks of stations so selected as to represent most suitably the different meteorological conditions prevailing in those regions. In each there is a scientific staff studying the problems that arise or affect the economic life of the country. Except as students of the same science, the interests of each service have been somewhat diverse from the nature of the requirements which each had to meet, but in future we must organise the provision of all information that aviation may require; and since aviators are going to pass from continent to continent and from one country to another, uniformity of some kind must be attained in respect of the assistance that meteorology is to give.

From the organisation necessary for Imperial co-operation to that of international co-operation is but a step, and the same requirements have to be considered; but some additional complications, such as variety of units, have to be reckoned with. But these have been successfully dealt with in the past; and as for many years the international work of meteorological services has paved the way for steady advance in our science, we may look with confidence to even greater progress in the future. The problems that press for early investigation are too numerous to recite, but a few may be mentioned.

The relation of meteorology to gunnery must be continued and the study of the many problems involved carried on by competent men.

The air routes of aerial transport will have to be studied and all the information now available must be sorted out, investigated, and discussed in order that it may be put in the form most suitable for use by airmen. This will demand much additional observing at many places besides the discussion of existing material, but unless this is done as part of a concerted scheme much unnecessary expense will be incurred, and the results will fall far short of what they should be, since all the data must eventually be worked up in connection with that from other places, and if all are not of the same scientific standard they cease to be comparable, and must often be rejected in discussion.

Many of the stations in the Crown Colonies can afford most valuable information in this connection if expert meteorologists are available to carry out the work. An observant traveller in Dahomey has remarked upon the presence of a steady north-easterly current at about 6000 ft. to 7000 ft. over the lower currents of the south-western monsoon of West Africa, and such information, if substantiated and extended, may be of material importance in this region.

While overland observations are numerous, and have been extended by means of *ballons-sondes*, aeroplanes, etc., to very great heights, our knowledge of the atmosphere over the sea is much less complete. By means of ships equipped for the purpose, such observations can be, and have been, made in certain parts, but this line of investigation must be extended if our knowledge is to be adequate.

Besides these more evident needs of aviation there are many problems of great practical importance which merit a closer and more thorough investigation than they have yet received. Among these may be suggested those violent disturbances known as hurricanes and typhoons. Recent theoretical investigations have thrown much light on their nature, and a further study of the evidence which exists should greatly add to our knowledge of them.

Variation of rainfall is always a matter of import-

ance, and in countries where it is barely adequate for agriculture any diminution of it is a serious matter, and such cases call for careful investigation.

The war has given a great impulse to meteorology by showing its possibilities to all, and aviation has made, and is still making, more and more demands upon it for information of every kind. Co-ordination between the services of each country and effective co-operation between the meteorologists in all parts of the Empire are the first essentials for meeting quickly and adequately the demands which will be made.

The "Manual of Meteorology" which Sir Napier Shaw has in hand will be of the greatest value in the work before us, for it will place in the hands of every meteorologist and student of meteorology a masterly treatise on those aspects of our science which he has studied for years, and of which he is the acknowledged exponent.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—At the annual meeting of the Court of Governors of the University, held on February 27, the Principal, Sir Oliver Lodge, announced his intention of resigning his post at the end of the present session. He said that, having passed the age-limit of the professorial staff, he wished to make way for a younger and more ambitious man, who would begin his duties with the period of reconstruction. He himself intended to devote the remainder of his life to the study of the æther of space in both its physical and psychical aspects. In seconding a resolution of deep regret, proposed by the Vice-Chancellor, Sir Richard Threlfall spoke in warmly appreciative terms of Sir Oliver Lodge's scientific work, especially in electrolysis, in the electrical deposition of smoke, and in wireless telegraphy, which had been of very great benefit to industry and to the world at large.

Sir Oliver Lodge, who took office nineteen years ago as first Principal of the University, has rendered invaluable service both to the University and to the city, and the close connection between the two which now exists is perhaps the best tribute to his work as head of the former. When the University first came into existence, as the result of the efforts of a very small but far-sighted body of men, it is not too much to say that the great majority of the citizens regarded it as a very unnecessary and entirely useless institution, which for some obscure reason Mr. Joseph Chamberlain considered a subject of vital importance to the city. To-day, however, this attitude has changed, and the University has become an integral part of the civic life of the city. This change, the magnitude and significance of which can be fully appreciated only by those who have witnessed it, is due in a very large measure to the personality and activity of Sir Oliver Lodge. He has not only convinced the public of the material advantage to be derived from having in its midst a centre of scientific teaching and research, but has also unceasingly insisted on the value of the humane studies to the life of the community. He has, in fact, taken a large and honourable share in laying well and truly the foundations of higher education in Birmingham.

CAMBRIDGE.—Dr. J. B. Hurry has offered to increase the value of the Michael Foster research studentship in physiology, founded by him in 1912, and tenable biennially, from a hundred guineas to 200*l*. A gift of three successive sums of 100*l*., to be paid at intervals of six months, has been offered for the assistance of research in the zoological laboratory by a benefactor who desires to remain anonymous.

Mr. W. M. Smart, of Trinity College, has been appointed chief assistant at the observatory.

The professorship of mechanism and applied mechanics, which was held by the late Prof. Bernard Hopkinson, has been formally declared vacant, and candidates are requested to communicate with the Vice-Chancellor on or before Monday, March 17.

LONDON.—The tenth annual report of the Military Education Committee of the University (for the year 1918), which has been presented to the Senate, refers with gratification to the letter from the King in which his Majesty sent an assurance of the interest with which he had learnt that the University of London Officers Training Corps continued "to uphold the record of splendid services which it has rendered in the past." The number of commissions granted to cadets and ex-cadets of the University of London O.T.C., and to other graduates and students recommended by the committee, increased during the year from 4040 to 4413. First commissions in the Army, Navy, or Air Force have been granted to 4101 former cadets. Of these officers 584 have fallen in the war. The number of distinctions gained by former cadets up to the end of 1918 is 1175, including V.C., 4; D.S.O., 39 (including three with a bar); Military Cross, 442 (including three with two bars and twenty-nine with one bar); Croix de Guerre, 21; Médaille Militaire, 1; mentioned in despatches, 480 (mentioned four times, 3; thrice, 16; twice, 56). A roll of war service for the University of London O.T.C. is being prepared, and will be published as soon as possible.

A sum of about 5133*l*. has been accepted by the Senate on the bequest of the late Dr. William Julius Mickle for the establishment, in honour of his great-grandfather, William Julius Mickle, the poet, of an annual fellowship to be awarded to graduates of the University resident in London who have specially distinguished themselves in the advancement of medical art or science.

OXFORD.—On March 4 the preamble of a statute making Greek optional in Responsions passed Congregation by 123 votes to 63. The statute was introduced by Mr. E. Barker, of New College, supported by the Regius professor of Greek, and opposed by the Regius professor of divinity and Mr. E. M. Walker, of Queen's. If the statute passes Convocation in its present form, natural science will be brought into Responsions for the first time, either this subject or mathematics, or a combination of the two, being made compulsory.

UNDER section 28 of the Education Act, 1918, which the Board of Education has now announced will come into operation on April 1, the persons responsible for the conduct of schools and educational institutions in England and Wales are, subject to certain exceptions, required to send to the Board of Education, Victoria and Albert Museum, South Kensington, S.W.7, before July 1, the name and address and a short description of the school or institution. The information is not required from the following schools and educational institutions:—(1) Schools and educational institutions in receipt of grants from the Board of Education or the Board of Agriculture. (2) Elementary schools certified by the Board of Education as efficient. (3) Secondary schools recognised as efficient under the Board's regulations. (4) Universities and university colleges. (5) Poor Law schools and schools certified under Part IV. of the Children Act, 1908. (6) Educational establishments under the administration of the Army Council or of the Admiralty. The responsibility for giving the

required information attaches to the secretary or person performing the duties of secretary to the governing body, or, if there is no governing body, the headmaster or person responsible for the management of the school or institution. Notice will be given in due course as to any further particulars which may be required under regulations made by the Board of Education. The Act lays it down that if such responsible person fails to furnish the information required, he will be liable to certain specified penalties. The particulars now demanded are necessary so that the Board of Education may have available the full facts as to the provisions for education in England and Wales, and of the use which is being made of them.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 20.—Sir J. J. Thomson, president, in the chair.—S. S. **Zilva** and E. M. **Wells**: Dental changes in the teeth of the guinea-pig produced by a scorbutic diet. The structure of the teeth of guinea-pigs subsisting on a scorbutic diet undergoes radical changes. The ultimate change is characterised by the total disorganisation of the pulp, including the odontoblastic cells. The earliest modification is observed at a period when no other systemic abnormality can be recorded with certainty, and is characterised by the alterations in the odontoblastic cells and by the dilatation of the blood-vessels of the pulp. Monkeys' teeth are also affected when these animals exist on a scorbutic diet. The bearing of the above results on human subjects is discussed.—W. E. **Bullock** and W. **Cramer**: A new factor in the mechanism of bacterial infection. The bacteria of gas-gangrene (*B. welchii, Vibrion septique*, and *B. oedematiens*) and of tetanus, when completely freed from their toxins, either by washing or by heating to 80° for half an hour so that spores are formed, do not produce the specific disease when injected into a mouse or a guinea-pig. The normal animal disposes of the bacteria mainly by lysis, and partly also by phagocytosis, and this defensive mechanism is so efficient as to render these bacteria non-pathogenic when injected by themselves. If a small dose of a soluble, ionisable calcium salt is injected together with the bacteria of their spores, the specific disease is elicited in a very virulent form. The chlorides of sodium, potassium, ammonium, strontium, and magnesium, when injected together with *B. welchii*, are not capable of producing gas-gangrene. From these experiments and other experimental evidence the conclusion is drawn that calcium salts, when injected subcutaneously, produce a local change in the tissues at the site of injection. The effect of this dosage is to bring about a local breaking down of the defensive mechanism against the bacteria of gas-gangrene and tetanus. The term "kataphylaxis" is proposed to designate this new phenomenon. Sterile watery extracts of earth are capable of producing this phenomenon.—Major W. J. **Tulloch**: The distribution of the serological types of *B. tetani* in wounds of men who received prophylactic inoculation, and a study of the mechanism of infection in, and immunity from, tetanus. In a previous communication to the Royal Society it was shown that *B. tetani* was susceptible of classification into a number of groups differing one from another in their serological reactions. As this finding might have an important bearing on the preparation of anti-toxin, as many strains of *B. tetani* as possible were investigated by the agglutination method: (i) from cases of the disease; (ii) from wounds of men showing no evidence of tetanus. The results obtained show that Type I. bacilli are but relatively infrequently obtained from wounds of inoculated men suffering from tetanus. Thus 19 out of 25 (76 per cent.) strains obtained from the wounds of men who showed *no* evidence of tetanus proved to be Type I. bacilli, while 41 per cent. of the strains obtained from men suffering from the disease proved to be of this type. This observation suggested that there was possibly a mono-typical immunity to each serological type, for the serum used for prophylaxis was prepared mainly from the products of Type I. bacilli. Experiments show that mono-typical anti-toxin neutralises the toxins of all the types. The precise quality, as well as the degree, of tissue debility produced by injury is of importance in initiating the process of infection in tetanus.

Zoological Society, February 18.—Dr. A. Smith Woodward, vice-president, in the chair.—R. I. **Pocock**: External characters of existing Chevrotains (Tragulina). The Indian species, commonly cited as *Tragulus memminna*, differs in so many important characters from the Malaysian species that it is necessary to sever it from them as a distinct genus, for which the name Maschiola, used by Thomas in a subgeneric sense, is available. In the absence of the interramal scent-gland, in the structure of the penis, and in the retention of shots on the pelage, Maschiola is a more primitive type than Tragulus, and resembles the still more primitive West African genus Hyomoschus.—K. M. **Smith**: A comparative study of certain sense-organs in the antennæ and palpi of Diptera.

Institution of Mining and Metallurgy, February 20.—Mr. Hugh F. Marriott, president, in the chair.—S. J. **Truscott**: Slime treatment on Cornish frames: supplements. This paper, which is one of a series published by request of the Tin and Tungsten Research Committee, relates to a number of experiments conducted with the view of determining the comparative values of fluted and plane surfaces, the most suitable length of bed, and other details connected with the improved recovery of tin in Cornish mills. A number of tests are recorded, made under varying conditions, and the results are embodied in a *résumé* which, after noting the factors governing frame-working which are thereby established, further deals with conclusions in respect to policy, with particular regard to rapid enrichment and complete fine grinding. The paper is illustrated by flow sheets explaining the practice on various Cornish properties.—E. **Edser**: The comparison of concentration results, with special reference to the Cornish method of concentrating cassiterite. This paper embodies an attempt to determine the relation between the enrichment attained by repetition of the concentration process, and the cassiterite that is lost. It is first assumed that the assay of any small increment washed off the surface used for concentration is proportional to the assay of the material on the surface, and it is shown that the assumption is correct, the amount of cassiterite lost during a complete washing being inversely proportional to the n^{th} power of the enrichment effected. The value of n thus indicates the economy of the process; the smaller the value of n the more economical will be the process. Experimental data are shown to support the conclusions reached, but additional investigations are called for.—G. F. J. **Preumont**: Wolfram mining in Bolivia. In view of the fact that wolfram is a product of outstanding importance, and that Bolivia is now yielding quite a considerable proportion of the world output, this paper should be of timely interest. A collection of statistics showing the production and distribution of wolfram in Bolivia

is followed by detailed descriptions of the principal mines and deposits, and particulars of the costs, system of working, conditions of labour, and mining laws.—C. W. **Gudgeon**: The Giblin tin lode of Tasmania. This is a deposit which has so far not been the subject of any published description. Like many another property which has since made good, this lode experienced a chequered career before reaching its present position. The author considers this to be a good example of persistence of ore in depth.

MANCHESTER.

Literary and Philosophical Society, February 18.—Mr. W. Thomson, president, in the chair.—Dr. H. **Wilde**: The mutual relations of natural science and natural religion.—J. Wilfrid **Jackson**: (1) "Shell-pockets" on sand dunes on the Wirral coast, Cheshire. The paper consisted of a short account of "shell-pockets" in general, and contained remarks on the age of the buried land surfaces in the neighbourhood. (2) A new Middle Carboniferous Nautiloid (*Coelonautilus trapezoidalis*). The species is founded upon two specimens: one from the Lower Coal Measures near Colne, erroneously figured by Wild in 1892 as *Nautilus subsulcatus*, the other from the Pendleside series, Pule Hill, Marsden. The species differs from *C. subsulcatus* in several important details, but presents some affinity with *C. quadratus*.

EDINBURGH.

Royal Society, January 20.—Dr. John Horne, president, in the chair.—Prof. **Harvey-Gibson** and Miss Elsie **Horsman**: Contributions towards a knowledge of the anatomy of the lower Dicotyledons. II.: The anatomy of the stem of the Berberidaceæ.—Also Miss Christine E. **Quinlan**: Contributions towards a knowledge of the anatomy of the lower Dicotyledons. III.: The anatomy of the stem of the Calycanthaceæ. These two papers are parts of a general investigation into the affinities of the lower Dicotyledons and the Monocotyledons, and contain a number of anatomical facts regarding the stem which support the view that the Dicotyledons are the primitive forms, from which the Monocotyledons have been derived.—Miss Maud D. **Haviland**: The life-history and bionomics of *Myzus ribis*, Linn. (red-currant Aphis). Among the many facts established it was shown that there are two forms of this species which differ in the minute structure of the antennæ and in the dimensions of the abdomen and wings, and are apparently correlated with the nature of the food. The species is migratory, and in summer colonises certain species of labiate and other weeds, but this change of host-plant is not obligatory, and the entire life-cycle may be passed on the red currant. There is a decline in fertility in the later summer, caused probably by lower birth-rate. This may be considered as one of the factors accounting for the frequent disappearance of the species in August and September.—Dr. C. G. **Knott**: Further note on earthquake waves and the interior of the earth. There was evidence that as the compressional and distortional seismic waves penetrated to greater depths, the distortional wave reached its maximum velocity at a less depth than the compressional wave. In other words, the rigidity showed signs of falling off in value, while the incompressibility continued to increase. The hypothesis that the earth consisted of a nucleus of non-rigid, highly compressed material encompassed by a shell possessing the properties of an elastic solid was found to fit well in with the facts, the radius of the nucleus being assumed to be four-tenths of the radius of the earth. These conclusions were based on the accurate determinations of the velocities of the seismic waves at various depths, and are in fair agreement with the views formerly advanced by Mr. R. D. Oldham.

February 3.—Dr. John Horne, president, in the chair.—Dr. J. M'L. **Thompson**: The stelar anatomy of *Platyzoma microphyllum*, R. Br. The conductive system of the stem of the Australian fern Platyzoma lies between the two extreme types of conductive systems in modern ferns. These are known as the protostele, with a solid cylinder, and the solenostele, characterised by a pithed tubular cylinder with both outer and inner phloëm and with gaps in its wall. In the Platyzoma there is the pithed cylinder, but no gaps and no inner phloëm. In the majority of specimens examined the conductive system was an unbroken and unperforated pithed cylinder, but in the smallest, and apparently youngest, specimen the conductive system was locally a protostele which was directly transformed as the stem was followed forward into the pithed cylinder without gaps in the wall and without inner phloëm. The facts were in favour of the view that the stele of Platyzoma is the result of upgrade development directly from within an original protostele.—Capt. E. W. **Shann**: The comparative anatomy of the shoulder-girdle and pectoral fin of fishes. The observations extend over a wide series of fish types, such as Rhina, Callorhynchus, Accipenser, Polypterus, and Zeus. A new nomenclature was introduced based on the divisions of the great lateral muscles which are found to be constant for any particular group of fishes. The primitive nature of the muscle system in Selachians is emphasised. Among the Holocephali certain characters foreshadow the condition which obtains in the higher vertebrates.—Sir Thos. **Muir**: Note on the determinant of the primary minors of a special set of $(n-1)$-by-n arrays.

PARIS.

Academy of Sciences, February 17.—M. Léon Guignard in the chair.—A. **Rateau**: The flow of gas at very high pressures. The classical formulæ are based on the gas law $pv=RT$, and these become inexact when p is high, several hundred atmospheres. Formulæ based on the characteristic equation $p(v-\alpha)=RT$ are developed.—J. **Drach**: The integration by quadrature of the equation $d^2y/dx^2=[\phi(x)+h]y$.—J. **Cabannes**: The diffusion of light by the molecules of the air. The proportionality predicted by the theory of Lord Rayleigh, between the luminous intensity diffused laterally by a transparent gas and the number of molecules in the illuminated volume, has been exactly verified by a method of photographic photometry devised by MM. Fabry and Buisson. Since certain ultra-violet radiations cause some complications, it is advisable, in the experimental verification, to suppress radiation with a wave-length below $0{\cdot}3\mu$.—P. **Braesco**: Precipitated amorphous silica. From experiments on the coefficient of expansion it is concluded that precipitated silica, dehydrated and heated to 600° C., is really amorphous silica, but if calcined at temperatures above 1000° C. it becomes crystalline in the form of cristobalite.—M. **Portevin**: The influence of various factors on the critical speed of tempering in carbon steels.—P. **Nicolardot** and A. **Reglade**: The estimation of zirconium. In a solution containing 20 per cent. of sulphuric acid zirconium can be quantitatively separated from iron, aluminium, and chromium by ammonium phosphate.—G. **Delépine**: The carboniferous limestone in the Lille district.—A. **Vacher**: An old direction of the Rance valley.—G. **Reboul** and L. **Dunoyer**: A rule for predicting barometric variations and its coefficient of certainty.—E. **Mathias**: Sketch of a theory of rain. The influence

of altitude.—**M. Molliard**: The production of citric acid by *Sterigmatocystis nigra*.—E. **Fauré-Frémiet** and F. **Vlès**: Are the laws of cicatrisation of wounds reducible to the general laws of growth of organisms?—A. **Lécaillon**: The reproduction and development of accidental bivoltins and of the first generation derived from them in the silkworm.

SYDNEY.

Linnean Society of New South Wales, October 30, 1918.—Prof. H. G. Chapman, president, in the chair.—Dr. R. J. **Tillyard**: The Panorpoid complex. Part ii.: The wing-trichiation and its relationship to the general scheme of venation. The hairs found upon the wings of all Holometabolous orders are classed as (1) *microtrichia*, minute hairs developed in connection with every unspecialised hypoderm cell of the wing, and (2) *macrotrichia*, larger hairs of the nature of sensillæ, only developed from special trichogen cells of large size. The arrangement of these hairs is called the wing-trichiation. The venational scheme is shown to consist of (1) *main veins* and their branches, which are preceded by tracheæ in the pupal wing; (2) true *cross-veins*, not preceded by tracheæ; and (3) the *archedictyon*, or original Palæodictyopterous meshwork formed of irregular venules, and only found complete in fossils. The Triassic fossil Archipanorpa possesses all these elements, but the archedictyon is aphantoneuric, or in process of becoming absorbed into the wing-membrane. With this fossil as a basis, the trichiation of the wings of all the orders of the complex is studied. It is shown that the most archaic forms all agree in having microtrichia all over the wing, but macrotrichia only upon the main veins and upon the membrane (the latter were originally carried upon the archedictyon, but became seated on the membrane when the meshwork disappeared), and not upon the true cross-veins. The various lines of evolution are followed out, showing a tendency in some orders to suppression of both kinds of hairs, and in others to the specialisation of the macrotrichia as scales, as in the Lepidoptera. Conclusions are drawn as to the probable phylogenies of the Orders.—Dr. H. S. H. **Wardlaw**: The relation between the fat-content and the electrical conductivity of milk. Removal of fat from milk increases the electrical conductivity. In a given sample of milk the increase of conductivity is directly proportional to the volume of fat removed. The increase of conductivity due to the removal of a given amount of fat is not the same, however, in different samples of milk. The average increase of conductivity due to the removal of 1 per cent. by volume of fat is 1·5 per cent.—J. L. **Froggatt**: A study of the external breathing apparatus of the larvæ of some Muscoid flies. It is shown that the maggots of blowflies of five species pestilent to sheep can be identified by the characters of the anterior and posterior spiracles, especially of the latter.—W. W. **Froggatt**: Notes on Australian sawflies (Fenthredinidæ). Particulars about four species are given, including a record of the death of cattle in Queensland from the abnormal habit of eating the larvæ of *Pterygophorus analis*.—R. H. **Cambage**: Notes on the native flora of New South Wales. Part x.: The Federal capital territory.

WASHINGTON, D.C.

National Academy of Sciences, December, 1918 (Proceedings, vol. iv., No. 12).—W. S. **Adams**: The absorption spectrum of the novæ. A discussion of Nova Aurigæ of 1892, Nova Persei of 1901, Nova Geminorum of 1912, and Nova Aquilæ of 1918. The displacements of the lines in all these stars are directly proportional to wave-lengths, and divide themselves into two pairs of equal amount. Of these the first pair of stars has exactly twice the displacement of the second. In the case of Nova Aquilæ there is a progressive increase in the values of the displacements of the absorption lines at successive dates. Various hypothetical explanations are discussed.—D. N. **Lehmer**: Jacobi's extension of the continued fraction algorithm. A closer study of Jacobi's expansion reveals a number of remarkable points. Six theorems are stated.—R. L. **Moore**: A characterisation of Jordan regions by properties having no reference to their boundaries. The theorem is proved. In order that a simply connected, limited, two-dimensional domain R should have a simple closed curve as its boundary, it is necessary and sufficient that R should be uniformly connected *im kleinen*.—J. A. **Harris** and F. G. **Benedict**: A biometric study of human basal metabolism. An analysis of measurements on 136 men, 103 women, and 94 new-born infants.—A. M. **Banta**: Sex and sex intergrades in Cladocera. The presentation of facts in regard to Cladocera, with the discussion of their significance with regard to sex intergrades in general, leading to the tentative conclusion that sex is always relative; and that while most individuals of whatever species are prevailingly male or prevailingly female, every individual may have something of the other sex intermingled with its prevailing sexual characters.—W. J. **Crozier**: The method of progression in Polyclads. In Turbellarians generally muscular operations analogous to those executed by the foot of Chitons and of Gastropods are essentially concerned in creeping locomotion.—R. **Ruedemann**: The phylogeny of the acorn barnacles. The derivation of an Eobalanus from a Rhinocaris-like Phyllopod is illustrated in a set of diagrams.—J. M. **Clarke**: Possible derivation of the Lepadid barnacles from the Phyllopods. So far as present knowledge extends, the metamorphoses of the Phyllopods into the two great branches of the barnacles were essentially contemporaneous.—T. W. **Richards** and W. C. **Schumb**: Refractive index and solubilities of the nitrates of lead isotopes. The difference in atomic weight of the lead (207·20 and 206·41) has no appreciable effect on the refractive index or on the molal solubility of the different samples of lead nitrate.—T. W. **Richards**, W. M. **Craig**, and J. **Sameshima**: The purification by sublimation and the analysis of gallium chloride. The method rests on the fact that gallium trichloride sublimes and distils at a low temperature, whereas the other chlorides likely to be associated with it are much less volatile.—T. W. **Richards** and S. **Boyer**: The purification of gallium by electrolysis, and the compressibility and density of gallium. The method of separating gallium from indium by means of the different solubilities of the hydroxides in caustic alkali was tested without success; much more promising results were obtained by the electrolytic method. The compressibility of solid gallium was found to be $2{\cdot}09\times10^{-6}$, and of liquid gallium $3{\cdot}97\times10^{-6}$, nearly twice as great, although its volume is less. The density of the liquid was 6·081, and of the solid 5·885.—A. G. **Mayor**: The growth-rate of Samoan coral reefs. The growth-rate of Acropora, Porites, Pocillopora, Pavona, and Psammocora are given, and the weight of limestone added per year to the upper surface of the Aua reef-flat is estimated as 805,000 lb. Other similar estimates are given.—A. van **Maanen**: The distances of six planetary nebulæ. The nebulæ N.G.C. 2302, 6720, 6804, 6905, 7008, and 7662 are examined. The parallaxes range from 0·002″ to 0·021″, and the diameters from 10,000 to 1350 astronomical units.

BOOKS RECEIVED.

What is Psycho-analysis? By Dr. I. H. Coriat. Pp. 124. (London: Kegan Paul, Trench, Trübner, and Co., Ltd., 1919.) 3*s.* 6*d.* net.

Calcolo delle Probabilità. By Prof. Guido Castelnuovo. Pp. xxiii+373. (Milano-Roma-Napoli: Società Editrice Dante Alighieri di Albrighi Segati & C., 1919.)

Ethnogeography and Archæology of the Wiyot Territory. By L. L. Loud. Vol. xiv., No. 3. (University of California Publications in American Archæology and Ethnology.) Pp. 221–436+plates 21. (Berkeley: University of California Press, 1918.)

Chimica delle Sostanze Explosive. By Prof. Michele Giua. Pp. xvi+556. (Milano: Ulrico Hoepli, 1919.) 28 lire.

Sanitation Practically Applied. By Dr. Harold Bacon Wood. Pp. vi+473. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1917.) 13*s.* 6*d.* net.

The Game Birds of California. Contribution from the University of California Museum of Vertebrate Zoology. By Joseph Grinnell, Harold Child Bryant, and Tracy Irwin Storer. Pp. x+642+16 coloured plates. (Berkeley: University of California Press, 1918.) 6 dollars net.

The Secret of Personality. The Problem of Man's Personal Life as Viewed in the Light of an Hypothesis of Man's Religious Faith. By Dr. G. T. Ladd. Pp. ix+287. (London: Longmans, Green, and Co., 1918.) 7*s.* 6*d.* net.

Osmotic Pressure. By Prof. Alexander Findlay. Second edition. (Monographs on Inorganic and Physical Chemistry.) Pp. xi+116. (London: Longmans, Green, and Co., 1919.) 6*s.* net.

An Advanced Course in Quantitative Analysis. With explanatory notes. By Prof. Henry Fay. Pp. vi+111. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1917.) 6*s.* net.

A Systematic Course of Qualitative Chemical Analysis of Inorganic and Organic Substances. With explanatory notes. By Prof. Henry W. Schimpf. Third edition, revised. Pp. ix+187. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1917.) 7*s.* net.

Differential Calculus. By Prof. H. B. Phillips. Pp. v+194. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1916.) 9*s.* 6*d.* net.

Empirical Formulas. By Prof. Theodore R. Running. (Mathematical Monographs, No. 19.) Pp. 144. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1917.) 7*s.* net.

DIARY OF SOCIETIES.

THURSDAY, MARCH 6.

ROYAL SOCIETY, at 4.30.—L. F. Richardson: (1) Atmospheric Stirring Measured by Precipitation; (2) Measurement of Water in Clouds.

ROYAL SOCIETY OF ARTS, at 4.30.—W. R. Gourlay: The Need for a History of Bengal.

LINNEAN SOCIETY, at 5.—Dr. Harold Wager: The Colour-sense of Wasps.—F. Lewis: Notes on a Visit to Kunadiparawitta Mountain, Ceylon, with List of the Plants observed and their Altitudinal Distribution.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—G. L. Addenbrooke: Dielectrics in Electric Fields.

CHILD-STUDY SOCIETY, at 6.—Miss S. Walker: The Training of Teachers from the Child-Study Standpoint.

CHEMICAL SOCIETY, at 8.—Prof. J. W. Nicholson: Emission Spectra and Atomic Structure.

FRIDAY, MARCH 7.

ROYAL INSTITUTION, at 5.30.—Prof. H. C. H. Carpenter: The Hardening of Steel.

SATURDAY, MARCH 8.

ROYAL INSTITUTION, at 3.—Sir J. J. Thomson: Spectrum Analysis and its Application to Atomic Structure.

MONDAY, MARCH 10.

ROYAL INSTITUTION, at 3.—Capt. G. P. Thomson: The Dynamics of Flying

ROYAL SOCIETY OF ARTS, at 4.30.—Prof. W. A. Bone: Coal and its Conservation.

SOCIETY OF ENGINEERS, at 5.30.—A. S. E. Ackermann: Experiments with Clay in its Relation to Piles.

ROYAL GEOGRAPHICAL SOCIETY, at 8.—Major J. B. Noel: The Eastern Approaches to Mt. Everest.

TUESDAY, MARCH 11.

ROYAL INSTITUTION, at 3.—Prof. H. Maxwell Lefroy: Insect Problems.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 3, with Prehistoric Society of East Anglia.—R. S. Smith: Presidential Address—Foreign Relations in the Neolithic Period.—At 5.15.—S. H. Warren: The Dating of Surface Flint Implements and the Evidence of the Submerged Peat Surfaces.—M. Léon Coutil: Note on an Allée Couverte Discovered in the Course of making Trenches for the Defence of Paris.

INSTITUTION OF CIVIL ENGINEERS, at 5.30.—J. Caldwell and H. B. Sayers: Electric Welding Developments in Great Britain and the United States of America.—W. S. Abell: Experiments on the Application of Electric Welding to Large Structures.—J. R. Smith: The Application of Electric Welding in Ship Construction and Repairs.

WEDNESDAY, MARCH 12.

ROYAL SOCIETY OF ARTS, at 4.30.—W. L. Lorkin: Electric Welding and its Applications.

GEOLOGICAL SOCIETY, at 5.30.—E. H. Pascoe: The Early History of the Indus, Brahmaputra, and Ganges.

ROYAL AERONAUTICAL SOCIETY, at 8.—H. Levy: From Model to Full Scale in Aeronautics.

THURSDAY, MARCH 13.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* Dr. A. D Waller: Concerning Emotive Phenomena. III.: The Influence of Drugs upon the Electrical Conductivity of the Palm of the Hand.—Dr. W. L. Balls: The Existence of Daily Growth-rings in the Cell Wall of Cotton Hairs.

ROYAL SOCIETY OF ARTS, at 4.30.—D. T. Chadwick: The Report of the Indian Industrial Commission.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—G. L. Addenbrooke: Dielectrics in Electric Fields.

OPTICAL SOCIETY at 7.—Major C. W. Gamble: Some Photographic Apparatus used in Aerial Photography.

FRIDAY, MARCH 14.

PHYSICAL SOCIETY, at 5.—C. C. Paterson and Dr. Norman Campbell: Some Characteristics of the Spark Discharge, and its Effect in Igniting Explosive Mixtures.

ROYAL INSTITUTION, at 5.30.—Prof. A. Keith: The Organ of Hearing from a New Point of View.

SATURDAY, MARCH 15.

ROYAL INSTITUTION, at 3.—Sir J. J. Thomson: Spectrum Analysis and its Application to Atomic Structure.

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