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Oceanographic Problems.

IT may be taken for granted that a new *Challenger* expedition, such as was suggested by Prof. W. A. Herdman in his presidential address to the British Association at Cardiff last August, would have for its *general* objects just those of the great voyage of 1872–76. One must remember that only an infinitesimal part of the ocean floor has been investigated by all the deep-sea exploring voyages yet organised. On the whole, then, a new expedition ought to make soundings, take temperature observations, trawl and dredge, etc., adopting the same attitude towards these matters as that already taken. The traverses across the great oceans would, of course, be different ones, so that new stations would be investigated—except where it may be desirable to check some of the former results—and here and there it may be found advisable to study some relatively small area intensively—that is, to make the observing stations much closer together than over the rest of the traverses. This ought to be practicable, for the improvements in the gear employed and in its management have been so great since 1872 that much more work should certainly be done in the same time than was possible on board the old *Challenger*. Just because of the enormous improvement in apparatus, it would be advisable to repeat much of the work of the former expedition, especially in areas that have not been touched by any of the later voyages.

Confirmation of many of the old results is absolutely necessary; for instance, much is to be learned by repeating the observations made by the German plankton expedition of 1889, especially in other areas than the Sargasso Sea. Such results would be of immense theoretical significance if they were obtained by the newer methods that have been developed, because of the criticism of Victor Hensen's original methods of quantitative plankton research. The same remarks may be made with reference to the collection of water samples from the surface and at all levels down to the sea-bottom. The activities of the nitrogen-bacteria were practically unknown in 1872, but they have been studied very closely since. Even the methods for the estimation of atmospheric gases dissolved in sea-water have been greatly improved, and a general study of the distribution of these at the bottom of the deep oceans would give information of great value in tracing movements of water-masses on the large scale. Something has been done since 1872 on the bacteria of the oceanic oozes and the overlying water, but mainly in rather shallow water and on a very limited scale; a big series of such samplings over the ocean far from the land cannot fail to have enormous interest. This, of course, is work that must be done on board ship, and will require exhaustive preliminary research into methods adapted to the rather trying conditions. With, however, a modern ship, electric incubators, refrigerating machinery, and so on, there is no insuperable difficulty. What may be really troublesome will be the elaboration of a thoroughly sound method of collecting samples of water and ooze from great depths by means that will satisfy a critical bacteriologist.

Thus, it may be agreed, the general outlook ought to be very much what it was in 1872, except that the most careful attention should be paid to methods, especially such as have been developed to an extent that the *Challenger* men of science of 1872 could not have anticipated. It is possible also that some of the devices adopted during the anti-submarine warfare of the last few years may have great potentialities, and if any confidential information of such promise is in existence it should be considered.

The results of the old *Challenger* expedition had, it is well known, certain important economic consequences, and this aspect of the new expedition should certainly be kept in mind. Here we are immediately concerned with the purely scientific interest of a renewed exploration of the ocean, but fishery research provides biological data of theoretical interest, and so it is quite properly a part of the programme of a deep-sea expedition on the great scale. One remembers, also, that such economic-marine exploration has been asked for by the owners of deep-sea fishing vessels; that the steam vessels employed in trawling always tend to become more and more powerful and to go further afield; that methods of conservation may quite conceivably make the products of tropical or polar seas accessible to the whole world (so that Dr. W. S. Bruce's idea of utilising penguin eggs as food for Europe is by no means absurd); and that British commercial enterprise is quite capable of establishing fisheries in any part of the world, if it is assured that there is a reasonable chance of success. One remembers that it was the exploration of the Stanton Banks off the Western Hebrides by Capt. Tizard in the *Triton* that led to the suggestion that fishing vessels might go there. The result was the sending of trawlers by Mr. George Moody, of Grimsby, and the subsequent exploitation of the now well-known Dhu Artach fishing-grounds. Mr. Tate Regan made the suggestion at the recent British Association meeting that an enormous area of sea-bottom off the South American coasts might be explored with much gain to ichthyology, but there may also be great potentialities for fishing in such a survey; and no doubt there are other promising regions that might also be examined. One must not forget that the modern steam trawler had not been "invented" when the old *Challenger* sailed, and so such an object as we suggest here was probably not in the minds of her officers and naturalists.

There are certainly many other lines of investigation that are either new or present themselves to us now in a new way. One feels, for instance, that the mode of origin of coral reefs, atolls, barriers, etc., has still to be investigated on a really comprehensive scale, and with all the methods of modern physical and biological chemistry. In this connection speculation and theory have far outrun observation to the extent that one is appalled at the task of examining the various hypotheses that have been made and of tackling the enormous literature. Some really big investigation of this subject is now imperative (if only from the point of view of the unhappy teacher of zoology!). There is probably (one finds it difficult to be sure) no adequate investigation of the physical chemistry of the water of a lagoon, considering such matters as CO_2-equilibrium between atmosphere and sea; changes in hydrogen-ion concentration; the effect of pelagic organisms, and their variability in abundance, upon these functions; the precipitation of calcium carbonate from solution by bacteria (work which is suggested by Drew's incomplete investigations in the Tortugas), and so on. In fact, the outlook upon coral formation and the growth of reefs is now entirely different from what it was in 1872. What is the *rôle* of commensal algæ and the Pütter method of nutrition of marine animals, for instance? And, in this connection, how *do* deep-sea animals really feed? There are no satisfying observations upon this point.

These considerations point to one direction in which the general methods of the old expedition ought to be revised. It is absolutely essential that a new voyage should be world-wide and comprehensive—more so than was the old voyage—and, given a well-chosen ship, this ought to be practicable. But, none the less, *intensive* investigation of relatively small areas is required—not such investigations as those of the Mediterranean, the Ægean, and the Baltic, for example (these ought to be the work of *local* expeditionary forces), but rather prolonged examination of oceanic islands, atolls, parts of a continental coast that have special significance, and so on. This can be attempted only by detaching parties (one or two men of science with assistants) from the ship and leaving them at such scientific, strategic points with all the materials and apparatus necessary for the research—whatever it may be. Perhaps a dozen or so such landing parties placed here and there over the world, relieved at intervals by the parent expedition and taken care of, would be almost as valuable to science as the main expedition. They could study temperature and salinity variations and meteorological phenomena, set up tide gauges, collect, analyse, and so on—there is no end to the work to be done.

This suggests a matter of organisation which may well be neglected: the *personnel* of the expedition must—if all that is suggested here is attempted—be rather large, and it could not possibly be obtained just now. It can be raised, given two years' notice of the certainty that an expedition will sail, for in that time men can be trained. Just now there must be many young men to whom it would be sheer joy to be destined for units in a new *Challenger* landing party, and the prospect of such an adventure would be a powerful incentive to sustained and earnest training. No doubt this is a matter which those who are trying to organise the expedition have in mind. No doubt also the evident shortcomings of the old expedition are being scrutinised—one suspects on reading the "Narrative" that there was a good deal of what is now called "joy-riding." These are details, perhaps, that are incidental to the planning of the scientific work, but they seem to be really important. J. J.

To the foregoing account of what it may reasonably be expected that an oceanographic expedition would accomplish, and of the preparation that will be necessary, we have now regretfully to append the announcement that the council of the British Association has reluctantly decided that the organisation of such an expedition on an adequate scale cannot be profitably promoted at the present time.

In accordance with the resolution passed by the general committee at the Cardiff meeting, the council appointed a special oceanographic committee to inquire into the details of the suggested project and to prepare a reasoned statement as to the need for such an expedition and its probable scale, scope, equipment, and cost. This memorandum has now been completed, and is available for use when the occasion arises; but in view of the present demand for economy in all national expenditure, and after consultation with trustworthy authorities, both scientific and administrative, the council at a recent meeting adopted a report by the general officers to the effect that, while retaining the scheme under consideration, no further action should be taken until circumstances seem more favourable for public expenditure upon such an undertaking.

The Oceanographic Committee will remain in existence with a watching and organising brief ready to revive the project whenever a favourable opportunity arises, and the council will doubtless report upon the whole matter to the meeting of the general committee of the Association at Edinburgh next September.

It is hoped that the proposed expedition is postponed only for a season, and that the interval may be usefully employed in perfecting plans and making other essential preparations.

Problems of Life and Mind.

(1) *The Ways of Life: A Study in Ethics.* By Stephen Ward. Pp. 127. (London: Oxford University Press; Humphrey Milford, 1920.) 6*s.* 6*d.* net.

(2) *Symbiosis: A Socio-physiological Study of Evolution.* By H. Reinheimer. Pp. xii+295. (London: Headley Bros., 1920.) 15*s.* net.

(3) *Free Will and Destiny.* By St. George Lane-Fox Pitt. With *Open Letter on the International Moral Education Congress and League of Nations.* By the Rt. Hon. Sir Frederick Pollock, and appendix by Frederick J. Gould. Pp. xix+100. (London: Constable and Co., Ltd., 1920.) 5*s.*

(4) *Beauty and the Beast: An Essay in Evolutionary Aesthetic.* By Stewart A. McDowall. Pp. vii+93. (Cambridge: At the University Press, 1920.) 7*s.* 6*d.* net.

THE solution of the problems of life and mind, to which George Henry Lewes addressed himself in mid-Victorian times, still exercises the thought of to-day. It is noteworthy that, although he did not make full use of the concept, Lewes, following Mill, urged that the kind of effect he called "emergent" (and Mill "heteropathic") is qualitative, new, or, as it is sometimes termed, "constitutive," and cannot, like "resultant" effects, be quantitatively deduced from given antecedents by a process of algebraical summation. On this, much modern interpretation turns. It does not, of course, follow that there are not laws of qualitative emergents, just as there are quantitative laws of resultants. Nor does it follow that, in life and mind, there is no hereditary transmission of emergent qualities. Nay, rather it may be said that the laws and the history of evolution are founded on emergence as, in the long run, the keynote of progress. In the system of philosophy which Prof. Alexander has recently laid before us the stages of emergence from the bosom of space-time are fully discussed.

Noteworthy, too, is Lewes's treatment of the unconscious, which, for him, was to be interpreted, after mid-Victorian fashion, in terms of physiology. That does not satisfy the thinkers of to-day. Many claim that, in psychical terms, all that is psychical must be interpreted; and if, in the midst of our fully conscious life, with its memory and anticipation, there surges up much that is new, and that, from its very newness, carries neither the again-ness of the one nor the not-yet-ness of the other, this must be interpreted as the outcome of psychical integration which has nowise been established in the conscious life of the individual concerned. It is not here a case, as in habit, of the submergence of that which has been integrated in the light of conscious purpose, but of the rising above the threshold of that which was integrated outside that individual life.

There are thus two forms of integration: (i) that which is established in the course of individual life above—for the most part in human life well above—the threshold of consciousness; and (ii) that which comes to each one of us in integrated form from the subliminal part of the psychical system to which we are heir. Neither of these can now be neglected; but one or the other may receive special emphasis. The stress in Mr. Stephen Ward's book (1) is on integration in the field of thought. Not readily is there to be found in such short compass so suggestive a treatment—no mere summary, but touched throughout with individuality—as that which is the foundation of his study of ethics. He insists that, for thought, every fact is a conceptualised fact, and inevitably to be taken as universalised; and "while we think in the present, *what* we think of is either past or future." Hence, "inasmuch as the present is not expressible in thought, it follows that the purpose of our being is not expressible in thought. For thought, the word 'purpose' always has a future reference; for life, our purpose is to be what we are, to have a present." And while, in life, so much is provided *for* thought to discuss, yet of this a great deal is nowise provided *by* the thought of the individual or the race. Its integration has been otherwise established.

The goal of reason is truth, and "the first necessity of reason is that it should be one and one only. There cannot [ultimately] be several kinds of truth. It must be self-standing and complete, for if it were not complete, it would depend on something outside itself—something, that is, which would be more true than itself." Whence "it is obvious that no experience of which we are capable could possibly fulfil these conditions." But the perfectly right, as the goal of duty, is in like position. Man is bound "to realise eventually that, situated as he is, all that he can know of reason or morality is that they are *not* what he is, because both require a freedom or completeness which his life is unable to supply." They are unattainable ideals, but thereby they lose nothing of their grandeur.

Here morality is dealt with *in excelsis*. A reasonable being and a moral being are one and the same—but beyond our reach. On the other hand, Mr. Reinheimer (2) seeks the roots of morality in the very beginnings of life. His advocacy of symbiosis, in his extended sense of the word, is well known from his previous publications. Making due allowance for some over-emphasis, pardonable in the advocate, what one may fairly regard as his main contention—that integration in bionomic relatedness is essential to the good of all concerned in the intricate web of life—is sound at the core. In this mesh of relatedness the nutritive factors demand as careful study as those which subserve the end of reproduction. Life as a whole is an integrated symbiotic whole; and if we be "sharers in a wholesome pan-psychism" we may fairly seek and find in the very foundations of organic evolution the foundations also of the integration of the unconscious, neither identifying the psychical with the physiological, nor accepting the mythological views of Maeterlinck and Samuel Butler (which are considered and criticised by Mr. Reinheimer), but regarding them as distinct, though, in some way, deeply and closely interrelated. Mr. Reinheimer, indeed, suggests that the physical and mental work together in internal or domestic symbiosis.

Thus, while, for Mr. Ward, at the upper limit of human thought is the concept of duty which under the conditions of our life cannot be reached, for Mr. Reinheimer the foundations of duty are laid in that integrated biological reciprocity to which he extends the concept of symbiosis.

Intermediate between these different levels on which the problems of life and mind may be discussed is the doctrine of the complex as affording the foundations on which a superstructure of consciousness is built. Mr. Lane-Fox Pitt, in his "Purpose of Education," of which his essay on "Freewill and Destiny" (3) is the sequel, says that a complex may be defined as a dynamic system of closely associated ideas linked together in some experience, or succession of experiences, with corresponding emotions, perceptions, memories, interests, and range of volitions. In every individual, he says, there are "egos" innumerable, and they all strive. Freedom is the escape from this bondage of strife. Our destiny is the conquest of this multiplex egoism. Hence it would seem that, alike in the realm of ethical thought, with which Mr. Ward deals, in that of symbiotic interrelatedness under Mr. Reinheimer's treatment, and in that of a complex of complexes founded on the unconscious, as interpreted by Mr. Lane-Fox Pitt, the direction of progress is towards further and fuller integration of factors which, under the correlative process of differentiation, tend to fall asunder.

When, in this difficult problem of the unconscious, we dig down to essentials, the question arises whether such a definition of a complex as Mr. Lane-Fox Pitt suggests can be accepted, at any rate so far as "the submerged part of the iceberg" is concerned. Are there ideas, or memory-images, or wishes, or thoughts in the unconscious? Or are there psychical processes, tendencies, dispositions, urges, hormes, or however else they may be named, which determine the character and colour of ideas which, as such, live only above the threshold? Under the influence of what some regard as picturesque Herbartian mythology, of Prof. Bergson's fascinating poetry, of the rather repellent Freudian treatment of the latent dream, we have an interpretation in terms of unconscious ideas and memory-images. Is this science or mythology? That is the central question, whatever the answer may be.

Lewes was tireless in his emphasis on the distinction between what he called empirical and metempirical treatment—between what one may speak of as integration in fact, and the real or supposed cause or source to which that integration is due. In his illuminating discussion of æsthetics (4), founded on Croce, but containing some interesting modifications of treatment, Mr. McDowall accepts the view that the only reality is living spirit, and that beauty is expression, or the form given by the spirit to its intuitions, through which it makes contact with reality; but whereas for Croce the living spirit is immanent and unfolding, for Mr. McDowall its ultimate explanation is in its relatedness to a transcendent source whence all personality is derived. *Our* "expression" enables us to realise a greater and more perfect Expression than ours. Love is relationship, and beauty the expression of relationship; but there must be reciprocity. Give and take must go hand in hand in the realm of personal being, which is the only ultimate reality. Beauty in evolution is the progressive purification of that which may have its temporal foundations in that impulse of sex which psycho-analysis reveals.

Now one may agree with Lewes that empirical and metempirical solutions of the problems of life and mind should be carefully distinguished. It may be that in matters of science the latter may, by a self-denying ordinance, be rigorously excluded; but they cannot be ruled out from philosophical discussion; and Mr. McDowall's well-developed thesis, in this and other writings, demands full consideration before a court in which not only men of science, as such, are represented.

Regarded, however, from the purely empirical point of view, æsthetic expression and its correlative impression must take their due place among the problems of life and mind. To whatever source the integration may be due, integration there is. Nay, but is there not more than integration? Is there not the progressive evolution of the new? Unquestionably there is; and for its interpretation we must accept the concept of emergence, emphasised by Lewes and elaborated by Prof. Alexander. How comes it that in thought there arise universals which cannot be got out of a mere summation of particulars? How comes it that the proteins of even closely allied species are different? How comes it that the unconscious complex has characters all its own? How comes it that from lust in the animal there is the beautiful expression of love in man? In each case there are emergent characters which cannot be interpreted as resultants in terms of algebraical summation. Science must accept emergence as a natural datum, in the absence of which there would be no evolution to be interpreted. It then falls to the lot of philosophy to ask and, if it may be, to answer the deeper question: What is it that makes emergents emerge?

Plant Biology.

A Text-book of Plant Biology. By Prof. W. Neilson Jones and Dr. M. C. Rayner. Pp. viii + 262 + vi plates. (London: Methuen and Co., Ltd., 1920.) 7*s*.

MANY have tried their hands at writing books on botany, and although not a few have achieved some success, none has won it in that full measure which to the uninitiated might seem so easy of achievement. The subject is so rich and varied, and plant life so intriguingly beautiful, that it is, indeed, hard to understand why we have to wait so long for a really good elementary text-book of botany. It may be that the older among us did in our youth drink too deep of the German springs of botanical knowledge, and that the supplies from those sources, though excellent for local consumption, have the defect which is often inherent in their mineral and yet stronger waters—that of travelling ill; or it may be that the writing of a good text-book of botany is in truth a peculiarly difficult task.

The science owns a broad domain—morphology, physiology, pathology, all lie within its range, and those botanists are few who have wide knowledge of them all. Moreover, the laboratory, which has done so much for research, has not proved so useful as a centre for the dissemination of knowledge. It is not a good propagating house, and as plants grown therein are apt to thrive but poorly, so books written by the dwellers in laboratories are perhaps lacking in freshness. This at least is true, that if an elementary text-book is to appeal to young people it must have something of the freshness of the fields and of the fragrance of their plants.

The great merit of the text-book by Prof. Neilson Jones and Dr. Rayner is that it has freshness and fragrance. The art whereby the authors have cultivated these qualities so successfully is, as becomes good art, not apparent. They have taken the old themes; but the setting is simpler. As is essential for the writing of a good book, the authors have morphological minds, and hence their work is well proportioned They write easily and simply; the careless English so frequently employed by writers of scientific and other literature is rarely used by them. Now and again they fall from grace—as, for example, in the use of "up" thrice on pp. 2 and 3; but in general the histology of construction—the phrasing—is as good as the morphological plan is sound. That plan consists in the distribution of the subject-matter under three headings: the plant as a machine (a "works" would surely be better), the plant as a begetter of machines, and the plant as a citizen of the world.

In the first division the main facts of plant physiology and morphology are described—experimental demonstrations being relegated to the end of the chapters; in the second section growth and reproduction, cell division and heredity are dealt with; and in the last section the ecology of plants is taught in a manner altogether fresh and delightful. From the point of vantage of a beech clump in the Berkshire Downs the authors survey the vegetation and show the near and far plant associations, plant societies, and the open and closed formations. What is no less acceptable, they spare their readers the overgrowth of terminology which, unless it be pruned hard, will choke the young plant of ecological science, and prove once again the truth of the old adage that "Botany is easier to learn than its nomenclature." The two former sections of the book are treated in a more conventional manner, and it may be that newness of presentation of physiological and morphological facts is as unnecessary as it is undoubtedly difficult.

If, as is to be hoped, a new edition of this book be called for, the authors might, perhaps with advantage, consider the advisability of jettisoning some of the wealth of information which they have included in the present edition. For example, alternation of generations is a subject which in its fullness makes a fine and impressive story, but it is small and unexhilarating beer when taken only in the fern. If alternation were to go, embryo-sacs might go also—that is, be left for later studies. The desire "to cover the ground," though warmly approved by publishers, is one which should be ruthlessly suppressed by every writer of an elementary text-book on botany. It would also be well to transfer the chapter on the soil which concludes it to an earlier place in the volume, for this chapter should certainly come before that on ecology, and would be aptly placed in that section of the work which deals with osmotic phenomena and the absorption of water by plants.

F. K.

British Coal-fields.

Coal in Great Britain. By Dr. W. Gibson. Pp. viii+311+viii plates. (London: Edward Arnold, 1920.) 21s. net.

THE need for a small book giving within a reasonable compass a trustworthy summary of the essential characteristics of the coalfields of Great Britain has long been felt, and, as might be expected from the high qualifications of the author, the present volume goes far indeed towards filling this want. The first few chapters have been practically rewritten from an earlier book by the same author entitled "The Geology of Coal and Coal Mining," but they have been amplified and brought up to date. If, however, any fault is to be found with this general portion, it is that the author has scarcely availed himself so fully as he might have done of the most recent researches on the subject, such as the monograph on the constitution of coal by Drs. Stopes and Wheeler, or the results attained by the admirable micro-sections of coal produced by Mr. Lomax. Possibly also the paragraph on the classification of coal might have been considerably expanded with advantage to several classes of readers.

It may be noted in passing that 6572 ft. is now no longer the greatest depth reached by a diamond bore-hole. This is the depth of the Paruschowitz boring, but it was surpassed some years ago by the Czuchow bore-hole, also in Silesia, which reached a depth of 7350 ft. The two chapters dealing with the stratigraphy of exposed and concealed coalfields respectively are very well written and illustrated, and should make the principles of this somewhat obscure subject intelligible even to the general reader, whose demands the author has obviously kept in view throughout the book.

The second part, which occupies about two-thirds of the work, consists of descriptions of the coalfields of Great Britain and Ireland. Naturally, the space that can be devoted to each is very limited, and, as the author himself points out in his preface, many details which may assume considerable local importance, but are relatively insignificant from a more general point of view, have perforce been omitted. The salient features of each field have, however, been carefully studied, and are stated in such a way as to give a sufficiently clear view of their various characteristics; perhaps it might have been preferable to have subdivided the coalfields of Scotland, and to have devoted at least two chapters to these, instead of dealing with all of them in one, although no doubt that chapter is relatively a long one. Whilst there are necessarily omissions here and there, partly for lack of space, as has already been pointed out, and partly because no two geologists are at all likely to agree as to the relative importance of certain features, actual mistakes are decidedly rare.

It might have been desirable to devote more care to the sketch-maps of the coalfields, for they are by no means so clear as they might have been made; for example, in the map of the Northumberland and Durham coalfield it is doubtful whether a certain line lettered as a dyke of igneous rock is intended to represent the author's idea of the course of a possible dyke of such rock, or whether it is meant for the approximate line of the great fault known as the Ninety Fathom Dyke. At the same time, it is only right to admit that the representation of geological maps in black-and-white upon a very small scale is by no means an easy matter. The author may fairly be congratulated on having compressed so much useful information within the limits of a small but well-balanced volume, and it is fortunate that it appears at a moment when the importance of an accurate knowledge of the coalfields of the country is becoming generally recognised.

H. L.

Practical Aeroplane Photography.

Airplane Photography. By Major H. E. Ives, U.S. Army. Pp. 422. (Philadelphia and London: J. B. Lippincott Co., 1920.) 18*s*. net.

MAJOR IVES was formerly officer in charge of the experimental department of the photographic branch in the American Air Service, and as such he and his collaborators have had access to the information, photographs, and drawings supplied by the Allies to the United States. He has therefore had a unique opportunity of compiling a book describing the practice of air photography in the war and the apparatus employed, an opportunity which has probably not been afforded to any other individual. The work undertaken has been, on the whole, well done, and an interesting book results. The numerous well-printed illustrations form one of the most noteworthy features; they include not only photographs of apparatus, diagrams, and interesting air views, but also many reproductions from the secret official publications of the Intelligence Branch of the British War Office, which have not hitherto been available in England. When looking through the 208 figures, one notices that in a few cases their source is acknowledged, but in the majority of cases figures are copied from English, French, or Italian sources without acknowledgment. Whatever may be said of this free use of English official photographs, the direct reproduction of five well-known diagrams drawn, we believe, by Capt. Durward, R.A.F., and of two tables copied from M. Clerc, without reference to their authors, can scarcely be passed without comment.

The sections of the book dealing with apparatus and materials are distinctly good. The author has selected his material well, and the only inaccuracy noted is in the description of the Williamson film camera. In describing tilt-recorders, the Goerz type only is figured and mentioned, though the Zeiss type was more commonly employed by the Germans. In his account of aerial photographic methods and the utilisation of photographs, the author is less fortunate, probably having little first-hand knowledge. His treatment of stereoscopy seems somewhat superficial, while his chapter on map-making is quite unsound. He has adopted the untenable view that a series of overlapping prints taken by a plane flying level at a constant altitude constitutes a complete pictorial map of the ground. This view may possess an element of truth when the ground is flat, but it cannot be used as a basis for aerial survey. It has already called down the contempt of surveyors, and in 1916 led the General Staff of the French Army to prohibit the use of photo-mosaics and squared maps made from them. Under the impression that an assemblage of photographs—or a photo-mosaic, to use a more precise term—is a map, the author goes on to give a useful description of the method by which such a mosaic is made, but is, in consequence, confused when he tries to introduce the work and suggestions of Bagley. Aerial map-making can be developed only by recognising that, while a photograph may seldom itself be regarded as a map, it does give a representation of the ground from which an accurate map can be compiled (so long as certain conditions are known). With a good modern lens aberrations are negligible, and every other factor may be determined more or less accurately; the greater the accuracy attained in the estimation of the factors—height and such like—the greater will be the accuracy of the resulting compilation.

The conceptions of metrophotography and photogrammetry do not seem to find any mention in the book. It is almost inconceivable that an author should devote a section of his book to aerial mapping without any reference to the work already done in survey by photography from balloons. The subject of mapping by aerial photography was of vital importance in the war, and is the most promising outlet for the aeroplane camera in peace; its inadequate treatment here forms a serious blemish on an otherwise useful book. H. H. T.

Our Bookshelf.

The Flowering Plants of South Africa. Edited by Dr. I. B. Pole Evans. Vol. i. No. 1, November, 1920. Pp. ii+10 plates. (London: L. Reeve and Co., Ltd.; South Africa: The Speciality Press of South Africa, 1920.) 15*s.*, coloured; 10*s.*, plain.

EUROPEAN gardens owe so much to South Africa for the plants which adorn them that the appearance of a South African *Botanical Magazine* is an event of considerable interest. Dr. I. B. Pole Evans, the energetic Director of the Botanical Survey of South Africa, who is editing "The Flowering Plants of South Africa," is to be congratulated on this new venture to bring the treasures of the South African flora to the notice of a wider public. In the preface it is stated that the publication is due to the keenness and interest of a South African lady, "whose love for her country and its natural beauties has been the means of procuring the necessary funds for the initiation of the work." The plants illustrated will represent so far as possible the flowering plants of the several provinces of the Union of South Africa.

It is unfortunate that in this first number the plants depicted, though familiar garden plants, are not for the most part of very special interest, and it is to be hoped that in succeeding numbers some of the less known and more striking flowers of South Africa will be represented.

The work being prepared in South Africa and produced in England has suffered considerably, and both the illustrations and the descriptions leave a good deal to be desired. The printing of the names at the foot of the plates is also unfortunate in view of the corrections that have had to be made in England in the text of plates 3 and 4, so that an incorrect name appears on each plate.

The experience gained from the publication of this first number will, we hope, lead to a considerable improvement in following numbers. In making criticisms on this useful and interesting venture it is realised fully how great the difficulties in its production must have been.

The Garden Doctor: Plants in Health and Disease. By F. J. Chittenden. Pp. x+154. (London: *Country Life*, Ltd.; New York: Charles Scribner's Sons, 1920.) 7*s.* 6*d.* net.

THERE are few gardeners, even scientific ones, who will not learn much from these pages, for Mr. Chittenden's position at Wisley gives him many opportunities of ascertaining the common pests of plants and their appropriate treatment. After giving an excellent and popular synopsis of the structure and physiology of the plant, he treats of those ailments due not so much to parasites as to wrong treatment. He deals with fungus pests by mentioning the common plants in alphabetical order, and in a few words sketches both diseases and treatment. His chapter on insect pests is not so good, though here, as throughout the book, he deals with principles, and if these are grasped the reader should be able to diagnose the nature, at any rate, of most of the common pests. There are chapters on fungicides, insecticides, and spraying generally, the usual formulæ being given. The illustrations on the whole are excellent, but lose much of their usefulness by having no text references, and appear to have been collected casually. Several of them are taken from the Ministry of Agriculture leaflets without acknowledgment, while others are of pests not mentioned in the book. The reference to the winged form of American blight as the "fly," and to the apterous form as the "insect," is not to be commended, while the full explanation of the plate of the "Daffodil Fly," which has a humorous touch, would be interesting. Despite minor criticisms which might be made, this is a most readable and interesting book. G. C. G.

The Birds of the British Isles and their Eggs. By T. A. Coward. Second series. *Families Anatidae to Tetraonidae.* Pp. vii+376+159 plates. (London and New York: Frederick Warne and Co., Ltd., 1920.) 12*s.* 6*d.* net.

THIS second series completes Mr. Coward's work on British birds, already favourably noticed in the pages of NATURE. It treats of the numerous and varied forms of aquatic and wading birds, storks, bustards, rails, pigeons, and the game-birds. The coloured figures, which represent practically every species, have been nicely reproduced in miniature from the late Lord Lilford's well-known book, most of them being the work of Mr. Archibald Thorburn. The coloured figures of the eggs are less satisfactory, but may be regarded as acceptable. In addition to these plates there are sixty-nine photographic illustrations of both birds and their nesting haunts. This wealth of illustration, in conjunction with the author's excellent and appropriate letterpress, renders this work the best of the minor books devoted to a subject which is ever growing in popularity.

Betty and Bobtail at Pine-Tree Farm. By Lilian Gask. Pp. 224. (London: G. G. Harrap and Co., Ltd., 1920.) 6s. net.

WE suppose that a book by this well-known author requires no commendation, but perhaps an appreciation in these pages may have a peculiar value. The story of a little girl's visit to a farm and what she saw of dog and sheep, weasel and vole, bat and eagle, and other creatures—it is not a work of science, of course, but a work of art; and how it is done who shall say? We could tell the same story, but no child would turn an ear. One must have the secret of the Pied Piper. It seems clear, however, that part of the success of the book must be due to its truthfulness—for the natural history seems all right, except a tale about golden eagles hunting the deer in Scotland. Another part of the success of the book must be due to restraint in giving information, for many books for young folks fail utterly in their Sandford-and-Mertonism. The boy explaining why bats are not birds would have been a bore if he had said another word, but he stops just in time. Goethe said something about this sort of thing! The rest of the attractiveness of the book is due to the art of the writer. We should add, however, that the coloured illustrations by Miss Helen Jacobs are charming, and the book is beautifully printed. We commend it heartily for young children.

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 Disintegration of Elements by α-Particles.

IN earlier papers one of us has stated that long-range particles which can be detected by their scintillations on a zinc sulphide screen are observed when α-particles pass through air or nitrogen, but not through oxygen or carbon dioxide. From the deflection of these particles in a magnetic field it appeared that they were charged hydrogen atoms, indicating that some of the nitrogen atoms were disintegrated by an intense collision with an α-particle.

In these preliminary experiments it was difficult to get definite information as to the range of these particles from nitrogen, and so to compare them with the H atoms set in motion by the collisions of α-particles with ordinary hydrogen. Recently, improvement of the optical conditions has made the counting of such weak scintillations much easier and more certain. We have been able to show definitely that the H atoms from nitrogen have a greater range than the H atoms from hydrogen, the ratio being about 1·4 to 1. For example, the H atoms liberated by α-particles of range 7 cm. from hydrogen or any hydrogen compound have a maximum range corresponding to 29 cm. of air; while those from nitrogen have a range of 40 cm. This result shows that these particles cannot possibly arise from any hydrogen contamination.

This observation has opened the way to a series of experiments on other elements. The material under examination, in the form either of gas or of a thin film of element or oxide, is exposed to the α-rays of radium C. Observation of the number of scintillations is made through a thickness of mica corresponding to a distance of 32 cm. of air, so that the results are quite independent of the presence of hydrogen or any hydrogen compound in the material.

In this way we have obtained definite evidence that long-range particles are liberated from boron, fluorine, sodium, aluminium, and phosphorus, in addition to nitrogen.

The numbers observed from boron and sodium are much smaller than those from the other elements mentioned.

The following elements showed very little, if any, effect at an absorption corresponding to 32 cm. fair, viz. lithium, beryllium, carbon, oxygen, magnesium, silicon, sulphur, chlorine, potassium, calcium, titanium, manganese, iron, copper, tin, and gold.

The gases oxygen, carbon dioxide, and sulphur dioxide were examined at absorptions of less than 32 cm. fair, and no trace of these particles was observed. We have not yet examined whether any of the other elements give rise to particles of maximum range less than 32 cm.

The particles liberated from all the first-mentioned elements have a maximum range of at least 40 cm. in air. In particular, the range of the particles from aluminium is surprisingly great, and certainly not less than 80 cm.

While we have no experimental evidence of the nature of these particles except in the case of nitrogen, it seems likely that the particles are in reality H atoms liberated at different speeds from the elements. Assuming that the law connecting range and velocity of the particles is the same as for the α-particle, it follows that the energy of the particle from aluminium of the maximum range of 80 cm. is about 25 per cent. greater than the energy of the incident α-particle.

It is of interest to note that no effect is observed in "pure" elements the atomic mass of which is given by $4n$, where n is a whole number. The effect is, however, marked in many of the elements the mass of which is given by $4n+2$ or $4n+3$. Such a result is to be anticipated if atoms of the $4n$ type are built up of stable helium nuclei and those of the $4n+a$ type of helium and hydrogen nuclei.

It should also be mentioned that no particles have so far been observed for any element of mass greater than 31. If this proves to be general, even for α-particles of greater velocity than those of radium C, it may be an indication that the structure of the atomic nucleus undergoes some marked change at this point; for example, in the lighter atoms the hydrogen nuclei may be satellites of the main body of the nucleus, while in the heavier elements the hydrogen nuclei may form part of the interior structure.

Until accurate data are available as to the effect of velocity of the α-particles on the number, range, and distribution of the liberated particles, it does not seem profitable at this stage to discuss the possible mechanism of these atomic collisions which lead to the disintegration of the nucleus.

E. RUTHERFORD.
J. CHADWICK.
Cavendish Laboratory, February 26.

The Atomic Volume of Isotopes.

AT the discussion on isotopes at the Royal Society on March 3 the question was raised as to within what limits of accuracy the conclusion is justified that the atomic volume of the various isotopes of lead is constant, and the following collected results may therefore be of interest. There are two sets of data. In one the density and atomic weight of lead from thorite have been compared with the values of ordinary lead, and in the other a similar comparison has been made for the lead derived from two uranium minerals. These two sets, of course, cannot be compared together, as the densities of specimens are comparable only when they have been prepared under identical conditions. With due attention to this point the relative densities are, in the case of lead, capable of determination to a very high degree of accuracy.

In the first set of data (NATURE, February 4, 1915) the density determinations agreed in the case of three determinations on 73 grams of ordinary lead to within eight units, and in the case of two determinations on 65 grams of thorite lead to within four units in the fourth place of decimals. The first two values of the atomic weights in the following table are single determinations by a modification of Stas's method, the lead being converted into chloride, *via* the nitrate, in a quartz vessel without transference, and the ratio $Pb : PbCl_2$ determined. The third value is that obtained by O. Hönigschmid in Vienna on another fraction of the same thorite lead used in the density determination by the silver titration method from four determinations of the ratio $PbCl_2 : 2Ag$ and four of $PbCl_2 : 2AgCl$, and the probable error is given as ±0·014 (*Zeitsch. Elektrochem.*, 1917, vol. xxiii., p. 161). The second set of data is that of T. W. Richards and C. Wadsworth (Journ. Amer. Chem. Soc., 1916, vol. xxxviii., pp. 221 and 1658). The atomic weights are also by the silver titration method. The value 207·20 for the atomic weight of ordinary lead has also been obtained by G. P. Baxter and F. L. Grover (Journ. Amer. Chem. Soc., 1915, vol. xxxvii., p. 1027), and the value 207·18 by O. Hönigschmid and Mlle. S. Horovitz (*Monatsh.*, 1915, vol. xxxvi., p. 355) by similar methods. (Compare also Ann. Rep. Chem. Soc., 1916, vol. xiii., p. 247.)

Variety of lead.	Atomic weight.	Density at 20°.	Atomic volume.	Difference from mean
Ordinary	207·199	11·3465	18·2619	+0·0009
Ceylon thorite... ...	207·694	11·3760	18·2572	−0·0038
	207·77		18·2639	+0·0029
		Mean	18·2610	
Ordinary	207·20	11·337	18·2765	−0·0026
Australian uranium ore	206·34	11·288	18·2796	+0·0005
Norwegian cleveite ...	206·085	11·273	18·2813	+0·0022
		Mean	18·2791	

The differences in the atomic volume are thus exceedingly small, and, moreover, they are not systematic. Rejecting the single determination of the atomic weight of thorite lead, it appears that ordinary lead with the intermediate atomic weight has an atomic volume slightly below that of the others. It seems quite safe to conclude that the atomic volumes cannot differ by so much as three parts in ten thousand and the atomic diameters by so much as one part in ten thousand.

FREDERICK SODDY.

Relativity and the Velocity of Light.

IN his article in NATURE of February 17 on the general physical theory of relativity Mr. J. H. Jeans refers to recent experiments of Majorana, and his remarks imply that these experiments rendered it "possible to watch the progress of the ripple directly" and to measure the velocity of light in its unidirectional course from source to receiver, with the result that this velocity was shown to be constant. He contrasts these experiments with the original experiments of Michelson and Morley, in which the mean velocity of light in its outward and return journey after its reflection from a mirror was dealt with. As the point in question is a fundamental one, and as a statement to this effect has been made before, I think the matter should not be passed over.

The experiments of Majorana referred to are doubtless those described in *Comptes rendus* (No. 14, tome clxv., 1917, and No. 2, tome clxvii., 1918) designed to show the constancy of the velocity of light relative to the observer when reflected by a moving mirror or when issuing from a moving source. I venture to suggest that these experiments do not bear the interpretation that Mr. Jeans puts upon them, and that the experiment has not yet been devised that will enable a comparison to be made between the velocity of light on its outward and return journeys along the same path, or that will give a measure of the velocity on a single journey. The author of these papers makes no claim to have done this. I fear such an experiment is impossible.

C. O. BARTRUM.

32 Willoughby Road, Hampstead,
February 24.

I HAD not intended to make the statement which Mr. Bartrum considers is implied in my words, and am sorry that in aiming at brevity I appear to have achieved only ambiguity. It need scarcely be said that I agree that no experiment has been, or can be, devised which can measure the velocity of light in any unidirectional course. The impossibility of any such experiment is, in effect, the primary postulate of the theory of relativity.

It is, nevertheless, possible to compare two velocities along the same unidirectional course, and this is what Prof. Majorana claims to have done.

The Michelson-Morley experiment gave us the sum only of the times of two separate journeys—from A (light) to B (mirror) and back from B to A. We cannot even speak of comparing the time on AB with that on BA until we have defined time at B in terms of the time at A. If this is defined in terms of the relativity relation $t'=\beta(t-ux/c^2)$, then the Michelson-Morley experiment is consistent with the two journeys being performed with the same velocity c, and therefore in equal times, but it does not of itself establish equality either of velocity or of time. The additional information provided by the experiments of Majorana does, I believe, enable this equality to be proved.

Consider the problem in terms of an æther and a FitzGerald-Lorentz contraction. According to the Michelson-Morley experiment, the time on the double journey is equal to

$$l_0\left(1-\frac{u^2}{c^2}\right)^{\frac{1}{2}}\left[\frac{1}{c-u}+\frac{1}{c+u}\right] \quad . \quad . \quad . \quad (1)$$

but there is so far no justification for identifying the two terms in this sum with the times of the separate journeys. The distributed expression for the time of the double journey might, in general, be of the form

$$l_0\left(1-\frac{u^2}{c^2}\right)^{\frac{1}{2}}\left[\frac{1}{c-u+\alpha}+\frac{1}{c+u+\beta}\right] \quad . \quad . \quad (2)$$

where $c+\alpha$, $c+\beta$ are the velocities through the æther on the two journeys. For this to conform to the results of the Michelson-Morley experiment, expressions (1) and (2) must be equal, requiring that

$$\frac{2c+\alpha+\beta}{(c-u+\alpha)(c+u+\beta)}=\frac{2c}{c^2-u^2} \quad . \quad . \quad . \quad (3)$$

Now impose a further velocity v on the whole Michelson-Morley apparatus, so that its velocity through the æther becomes $u+v$. The first result of Majorana (*Phil. Mag.*, vol. xxxv., p. 173) shows that β remains unchanged. His second result (*Phil. Mag.*, vol. xxxvii., p. 149) shows that α remains unchanged. The time of the double journey is accordingly obtained by replacing u by $u+v$ in expression (2), and the Michelson-Morley result requires that equation (3) shall remain true when $u+v$ replaces u. Since Majorana's results held over a considerable range of values of v, it appears that (3) must be true for a whole range of values of u, requiring at once $\alpha=\beta=0$, so that the two terms in expression (1) must represent separately the times of the inward and outward journeys.

Translate this into relativity language, and it appears that when x, t, x', t' are related by the usual Lorentz transformation, then the Michelson-Morley experiment, when supplemented by the observations of Majorana, shows that both on the outward and on the inward journey light travels with the same constant velocity c. J. H. JEANS.

Relativity and the Deviation of Spectral Lines.

THE prediction of the Einstein spectral-line effect rests on two assumptions, namely, (1) the radiating source behaves as a natural clock, and (2) the time-period of the source is transmitted by the radiation to the observer.

An alternative to the second of these assumptions is that the radiation transmits the Einstein interval ds rather than the time interval dt of a vibration. This alternative appears to be more in accordance with the general ideas of relativity.

Consider two light pulses leaving A at times t_A, t_A+dt_A, and arriving at B at t_B, t_B+dt_B. Since $ds=0$ along the world line of each pulse, it appears that the interval $\gamma_A dt_A$ between the two departures from A is equal to the interval $\gamma_B dt_B$ between the arrivals at B—that is, the Einstein interval, and not the time interval, is transmitted.

If this contention be correct, the Einstein effect should arise, not from the transference of the source, but from the transference of the observer to a different gravitational field.

It may be contended that the use of the principle of least time in the ordinary method of deducing the deviation of a beam by a gravitational field presupposes an underlying constant time period in the radiation. To this I would reply that it is possible to deduce the deviation without any reference to pre-Einstein physics. I propose to deal with this point in a communication to the *Philosophical Magazine*.

H. J. PRIESTLEY.

University of Queensland, Brisbane,
January 15.

Amplifying the Optophone.

MR. CAMPBELL SWINTON'S forecast in NATURE of March 3, p. 8, has been fully verified since he wrote. On Tuesday, March 1, the Marconi Co. kindly lent me one of their three-valve amplifiers working with an S. G. Brown loud-speaking telephone and wooden trumpet. Mr. F. Swann, of the Marconi Co., personally superintended the installation, and we succeeded without much difficulty in producing a sound which made ordinary printed matter "legible" to several blind pupils in a room. A reading demonstration from the amplified sound was given in the presence of Sir William Collins and Mr. C. P. MacCarthy.

This new development marks a great step forward, and I consider that Mr. MacCarthy and Mr. Campbell Swinton deserve credit for their initiative in this matter. E. E. FOURNIER D'ALBE.

10 St. James's Terrace, N.W.8, March 5.

WITH reference to the letter on the above subject in NATURE of March 3, it may be of interest to record that thermionic amplifiers were applied to the optophone a considerable time ago with the object of increasing the sound in the ordinary telephone, but although it was evident that the sound could be amplified, it was decided that to increase the cost and complexity of the instrument to the extent involved by the addition of an amplifying set was not justified.

In 1919 Messrs. Barr and Stroud, Ltd., applied to Messrs. Marconi, of Chelmsford, who were kind enough to prepare a special amplifying set.

At a later date, through the kindness of Major Henrici, the valuable advice and assistance of officers of the Signal Department at Woolwich were also obtained.

Mr. Swinton, by the application to the subject of his great experience of amplifiers, has attained most encouraging results in making the optophone notes audible for instructional purposes.

JAMES WEIR FRENCH,
Director, Barr and Stroud, Ltd.

Anniesland, Glasgow, March 7.

The Peltier Effect and Low-temperature Research.

I WAS much interested to see Mr. A. A. Campbell Swinton's letter to NATURE of February 24, p. 828, on the above subject. So far as I am aware, the first suggestion to attain low temperatures by means of the Peltier effect was made by me when a student some twenty years ago. If Mr. Campbell Swinton will look up NATURE of August 15, 1901, p. 376, and also the *Chemical News*, 1901, vol. lxxxiv., p. 73, he will see an article by myself entitled "On a Possible Method of Obtaining the Absolute Zero of Temperature," in which the method is suggested in detail. There is little doubt that a great field of research would open out once the absolute zero of temperature were obtained, and temperature as a phase vanished from matter.

Attention may also be directed to a paper by Mr. Brinkworth and myself entitled "On the Heatless Condition of Matter" in *Chemical News*, 1902, vol. lxxxv., p. 194. Of course, it must be recollected that we were writing twenty years ago, long before modern developments occurred. Unfortunately, I have been out of touch with such matters, and have not had the opportunity of seeing whether any researches have been carried out on these lines owing to my work developing in a different direction.

GEOFFREY MARTIN.

109 Corporation Street, Manchester,
March 2.

WITH reference to Dr. Geoffrey Martin's interesting letter, it was because I thought it very possible that the idea was not new that I put my suggestion in the form of an inquiry. I have looked up his several most suggestive papers, which fully bear out what he says.

As I have pointed out, since the date of Dr. Martin's communications to NATURE and to the *Chemical News* in 1901, Prof. Kamerlingh Onnes has verified the disappearance of electrical resistance at very low temperatures which Dr. Martin, amongst others, predicted. It does not appear certain whether at such temperatures, when electrical conductivity in metals becomes infinite, either the Peltier effect or the corresponding opposite thermopile effect would operate.

Perhaps these effects may be enhanced, but possibly they may disappear; much would appear to depend upon how these low temperatures affect heat conductivity, with regard to which, I fancy, little is known. For instance, with temperatures at which electrical conductivity becomes infinite, does heat conductivity also become infinite? It would seem that this can be determined only experimentally. Perhaps Prof. Onnes, or someone else who possesses the necessary apparatus, could be induced to try the experiment. Let us hope that someone will do so.

A. A. CAMPBELL SWINTON.

66 Victoria Street, London, S.W.1, March 5.

The Sound of Distant Gun-fire.

THE results of the comparison of observations made on both sides of the fighting line upon the long-distance audibility of gun-fire have been rather disappointing. It appears that in Belgium and Germany a very marked maximum was found everywhere in the cold season, while in England and France the sounds were perceived in the summer months only. Moreover, in the latter countries the guns were never heard when the wind was blowing from the battle-fields towards the observers, while in the former the direction of wind seems to have been of little importance.

The vertical distribution of temperatures and variations of wind velocity with altitude are generally recognised as the chief factors of the curvature of the trajectories of sound, and they both bend the sonorous rays upwards when temperatures are diminishing and the strength of a head wind is increasing with altitude. The former is at its maximum efficiency in summer, when there is a steep gradient over the surface of the earth; the other is nearly always a characteristic of air-flows, since, as a rule, friction against the soil retards the lower strata. It appears, therefore, at once that the long-distance transmission of gun-fire sound was observed in England and France when the conditions favouring the bending upwards of the rays were at their best. On the other hand, there seems to have been nothing particularly favourable to their being bent downwards in the upper air; first, because in summer temperature inversions at moderate heights are rare, and, secondly, because the contrary wind that was wanted was from between south-west and north-west, and it is a well-known fact that this wind generally occupies at all seasons the whole height of the troposphere. True, its speed begins usually to slacken above 11 km., and at about 20 km. eastern components appear. But one might rightly fear that rarefaction of the atmosphere at such altitudes must already have reduced the intensity of sound greatly.

Now, on the German side it is quite the reverse; the influences that curve the rays upwards are at their lowest when the maximum of audibility occurs, since this is the case in winter, when the gradient of temperature is very feeble and often reversed, and with indifferent direction of wind. But these very inversions are a powerful cause of bending the rays downwards. Thus with the ordinary wind-temperature theory we cannot escape an almost complete contradiction.

The hydrogen-atmosphere theory of van den Borne and van Everdingen cannot help us out of this perplexity, since in this theory the long-distance perceptibility of sound should be quite independent of meteorological conditions, not to speak of the insuperable difficulty of attributing sufficient intensity to a sound travelling through a vacuum of 0·01 cm. at 70 km.

I therefore think there is only one way of escape, namely, to advocate *diffraction*. It is well known that sonorous rays are endowed with this property in a remarkable degree, and along such flat trajectories as must be the case in the long-distance propagation of sound, refracted rays cannot fail to diffuse to the earth all along. It is rather surprising that there should be a silent zone at all. Now, in ordinary circumstances these refracted rays, coming back to earth in all directions from the source, would be too faint to be perceived by any but a very attentive and well-trained ear as soon as a moderate distance from the centre of emission is reached. Should, however, any cause productive of upward curvature bend the rays that make a small angle with the horizon, then a caustic will be formed by these rays, and also by the diffraction rays issuing therefrom, so that the intensity of sound in these bundles of diffracted rays will grow sufficiently for hearing to be possible. The causes of upward bending, viz. vertical gradients of decreasing temperature and decreasing force of wind, are as a rule the more marked the nearer the earth one considers them. Thus the rays nearest the horizon are the most energetically bent, and the whole group intersect one another at small angles, thus forming beams where intensity is at a maximum.

In this theory diffraction would be the normal cause of the return to the earth of the sonorous waves in England and France; temperature gradient and contrary wind would only have to concentrate the rays in caustic bundles in order to intensify the sound at great distances. If temperature inversions and change of wind velocities or directions add their influences in order to bend the sound-tracks downwards, as in the German winter conditions, the direct rays themselves might be deflected towards the earth.

In this way everything seems to have a satisfactory explanation except the summer minimum of Germany. This is a very remarkable feature indeed, and very perplexing, for in summer as well as in winter the conditions for the return of the sound rays seem to be altogether more favourable on the German than on the Anglo-French side. For over the contrary east winds that bend them upwards flow, as a rule, the permanent west currents of the higher troposphere, the effect of which is to bend them down. One might wonder whether, perhaps, their bending effect is not *too* strong, and whether all but the rays damped by their passage through highly rarefied air are not brought back to earth *too soon* for a long-distance audibility zone to be possible! This hypothesis seems worth examining closely.

At any rate, the problem has lost its pleasing simplicity, and there is little hope that observations made during the war and not yet published will solve it adequately. One thing, therefore, remains to be done, and that is to turn to that supreme criterion—experiment.

Now this means organisation with vast resources and on a huge scale. Batteries should be fired on some suitable spot of the ancient Front (to facilitate taking into account the observations of the war) and observers posted along well-chosen lines, chiefly in the directions against and with the wind, at various distances in the air as well as on the ground. The salvoes should be fired at pre-arranged hours, so as to permit of calculating the trajectories travelled through by the reports. At the same time, and about the same places, meteorological observations as complete as possible should be made, and they, too, should be taken by aeroplane and dirigible at all suitable heights as well as on the earth.

No doubt this would be a tremendous business. But let it be remarked that there was a long period of time when it could have been done with little cost and scarcely any difficulty; this was in the months following the conclusion of peace, when immense dumps of ammunition and enemy ordnance had to be destroyed, as well as thousands of aircraft, and when thousands of airmen and many war-meteorologists were waiting for demobilisation.[1] Is it not a pity that all these forces have been left unemployed? There still may be enough of them left to attempt to execute at least part of such a programme. But there is no time to lose, for every step that brings us nearer complete demobilisation diminishes the facilities and enhances the cost of the undertaking.

V. SCHAFFERS, S.J.

Louvain, January 28.

The Designation of Vitamines.

THE opinion now appears to be general that the bodies known as accessory foodstuffs should not be termed "vitamines," as they have not been proved to be amines, and, in fact, nothing appears to be known of their constitution. Recently the name has been written "vitamin," but this is not sufficiently distinctive for the spoken word unless the termination be pronounced as "mĭn," *i.e.* with the "i" short.

If American authors cut off the final "e" from "amine," as some do from chloride, iodide, sulphide, sulphate, etc., the dropping of the "e" from "vitamine" will not help matters so far as such authors and their readers are concerned. I hope that the practice of dropping the final "e" will not spread to English writers; for, although we should probably soon get used to the appearance of chlorid, sulphid, sulphit, sulphat, phosphat, etc., there may be a tendency for some to pronounce these words with the "i" short as in "fit" and the "a" short as in "fat," while others would naturally retain the present pronunciation; it is most undesirable to have two different pronunciations for one and the same substance. The method of spelling sulphur and its derivatives as sulfur, sulfates, etc., cannot affect the pronunciation, and, moreover, the "ph" has crept in in error.

The "vitamines" might have been appropriately called "vitallines," which would indicate the vital part they play in nutrition, but that is, perhaps, too near to "vitelline" in sound and unnecessarily long; if they were termed "vitams," "vitans," "vitines" ("vitines" is probably more euphonious than "vitams"), or "vitins," all possible chance of confusion with other bodies would be avoided. The different varieties could be distinguished by A, B, etc., as has been proposed, or by α, β, γ, etc., in accordance with the usual practice of so indicating closely related chemical substances; or the water-soluble varieties might be written as w.s., or simply w., vitams, and the fat-soluble ones as f.s. or f. vitams; the letters w.s. or w. and f.s. or f. would at once be recognised as indicating their solubilities in water or fat, and there would not be the same difficulty to the reader of recollecting what A, B, etc., stand for.

A. LIVERSIDGE.

Kingston Hill, Surrey.

Scientific Names for Commercial Timbers.

IN the notice of "A Manual of the Timbers of the World" in NATURE of September 16, 1920, the reviewer's final paragraph reads as follows:—"Endless embarrassment to the landowning class resulted during the war from the confusion between the names 'silver spruce' and 'silver fir.'"

Now, from my experience in the use of both scientific and common names, I feel sure all this confusion could have been obviated by using scientific names only, for in this case the timbers referred to are both generically and specifically different, viz. *Picea sitchensis* and *Abies pectinata* respectively, and, naturally, differently textured timbers. Although it is a long way from "down under," I make this appeal to the scientific man in the homeland, hoping that he may prevail on the commercial man to use scientific names exclusively, and to show him how by his following a scientific lead it will be to the latter's financial advantage.

Much confusion existed in the nomenclature of the product produced by eucalyptus-oil distillers when the Sydney Technological Museum first undertook research in this field of economics in 1897, for then it was only with the greatest difficulty that oils true to name could be obtained, all and sundry leaves being put in the still. By using scientific names only from the start, the pharmaceutical, perfumery, and other industrial enterprises have in this direction been so much assisted that the industry is placed on such a scientific basis that all orders for Australian oils are given under scientific names, the common names being absolutely discarded, and so putting a stop to endless confusion such as one finds in the timber trade.

If this can be accomplished throughout the whole essential oil trade, from oil distillers in the bush to the city merchants, and finally to the chemist and pharmacist, surely the timber trades and foresters are not to be regarded as having a *personnel* on a lower intellectual plane than, say, the bush distiller.

This confusing of common names in Australia also gives great trouble to the various trades using timbers; to give one instance only, there are five distinct species of Proteaceous timbers placed on the Sydney market under the name of "silky oak." In order to assist the trades, I was moved to write a paper on the subject, which was read before the Royal Society of New South Wales. As a result, several firms are now specifying scientific names when placing orders for "silky oak," as they know that by so doing they will obtain the exact kind of timber they want for their requirements, and insist on having that particular timber; so in the end there is satisfaction all round.

RICHARD T. BAKER.

Technological Museum, Sydney, N.S.W., January 6.

"Elementary Practical Biochemistry."

IN the otherwise discriminating and useful review of my little book, "Elementary Practical Biochemistry," which appeared in NATURE of November 25 last, there are certain statements due to a misunderstanding which I should like to correct, as they might lead to an unjust estimate of the standards in the medical school with which I have the honour to be associated. The reviewer regrets that insufficient attention is paid to preparative and quantitative work, whilst the absence of treatment of hydrogen-ion determination constitutes a "serious defect."

As the preface indicates, this volume is one of three. Of the other two, one is to be devoted to clinical applications, and the remaining one to preparative and quantitative procedures. There is already in the press a detailed description of hydrogen-ion determination by the indicator method, and also by the electrical method, using the Leeds-Northrup potentiometer and a special electrode which is the outcome of some years of patient investigation by Dr. J. M. Lewis, a research student in my laboratory.

W. A. OSBORNE.

University of Melbourne, January 24.

[1] [This suggestion was put forward by Prof. de Quervain in January, 1919, and is referred to in NATURE, vol. cii., p. 371, and vol. ciii., p. 31.—EDITOR.]

Colloids and Colloidal Electrolytes.

By PROF. J. W. MCBAIN.

COLLOIDS comprise all matter that is made up of particles smaller than a wave-length of light, but larger than a single molecule of an ordinary crystalloidal substance such as sugar, salt, or water. It would appear that in some cases the chemical molecules are linked together into particles of colloidal dimensions, and then from these particles are built up the familiar structures such as rubber, fibres of cotton, wood, or earthenware. It is a moot question as to whether, in the case of certain highly complex organic substances, the single molecules themselves may not be large enough to exhibit the distinctive properties of colloidal particles.

Scientific study has been devoted almost exclusively to mixtures in which colloidal particles are dispersed throughout a second continuous medium; such as in many precious stones, ink, the body fluids, or a bar of soap where the continuous medium is water. Furthermore, the investigations of physical chemists have been directed almost entirely to the study of very dilute colloidal solutions (sols) such as dilute suspensions of gold or arsenic trisulphide in water, whilst biologists have devoted a great deal of attention to gelatin and protein, colloids of a very different type. For this reason the innumerable observations that have been made on colloids have not been well linked up either with each other or with our general scientific knowledge. There are, however, two outstanding instances in which some of the familiar and unambiguous methods of classical physical chemistry have been extended to the study of highly characteristic colloids—namely, soaps, chiefly studied in this country, and proteins, chiefly elucidated by W. B. Hardy and by the professor of biophysical chemistry in Vienna University, Wolfgang Pauli.[1] It now appears that soaps, proteins, and gelatin salts are closely similar types of substances, whilst soaps are by far the most accessible to quantitative measurements.

A very important characteristic of most colloidal solutions which have received careful study is the fact that the colloidal particles possess electrical charges. For instance, silver particles of diameter of about 500 millionths of a millimetre, suspended in water, move under the influence of an electric field. This must be ascribed to electrical charges on the particles, and calculation shows that on each such particle there are anything up to 100 million negative charges or electrons. This electrical charge seems enormous until we reflect that it is relatively ever so much less than the number of atoms of silver, and that in an ordinary ion there is one electrical charge for each atom.

The stability of the dilute suspensions of such insoluble substances greatly depends upon these electrical charges.

As will be shown, these "irreversible" or "suspensoid" particles, which have been so largely studied, occupy an intermediate position between electrically neutral colloidal particles, such as rubber in solution in benzene, and the much more highly charged colloidal particles known as the ionic micelle that occur in such aqueous solutions as those of soap. In the ionic micelle or particle the number of electrical charges is commensurate with the number of molecules or ions which have aggregated together.

Another prominent characteristic which physical chemists have met in attempting to study suspensoid colloids is their extreme variability and sensitiveness to all sorts of disturbing influences. It has become almost an axiom that only variable and non-reproducible results can be expected, and that they depend on the individual specimen examined. It is all the more fortunate, then, that in the case of soap solutions it is possible to obtain quantitative reproducible results depending only upon the composition and the state of the system. This has enabled us to investigate through these comparatively simple substances of known molecular formulæ and structure some of the characteristic properties exhibited by solutions of so many of those extraordinarily complex chemical substances, mostly of unknown formulæ, which are involved in all life processes, and are frequently of very great industrial importance. Salmon's suggestion is that these colloids should be called "equilibrium colloids," a classification that would in practice more or less correspond to the present modified use of Hardy's term "reversible colloids," now used chiefly with reference to the properties of dried residues. The expression "equilibrium colloids" has the advantage of possessing a rather deeper significance.

In the study of soap solutions in the Bristol University laboratory, it was first established that they exhibited excellent electrical conductivity even in the most concentrated viscous solutions. The change in conductivity with concentration exhibited remarkable anomalies such as had hitherto been met with only in certain non-aqueous solutions. The curve passes through both a maximum and a minimum in moderately strong solution. At this time it had been generally considered that colloids as such could not exhibit conductivity, and if observed it was ascribed to impurities and admixtures.

Although there were no admixtures in the case of these specially pure soap solutions, no data at all existed with regard to the amount of alkali set free in the solution through hydrolysis of the soap by the solvent water. Direct measurements succeeded in showing through two independent methods, electromotive force and rate of cata-

[1] A comprehensive summary of Pauli's masterly researches on this particularly complicated material is to be found in his "Kolloid-chemie der Eiweisskörper." Pp. 109. (Dresden and Leipzig: Th. Steinkoph, 1920.)

lysis, that the hydrolytic alkalinity of soap solutions is for most purposes negligible, and hence that the conductivity observed must be proper to the soap itself. Incidentally, this result is of interest in showing that the process of saponification in the manufacture of soap could be much more complete than was thought by such authorities as Lewkowitsch.

A further essential stage in the development of this problem was attained through the study of the osmotic activity of the soap solutions. This property is, in such cases, surprisingly inaccessible to trustworthy quantitative measurement. However, a development of Cumming's dew-point apparatus gave a general method of securing data, and the results were confirmed by cryoscopic measurements upon the few soaps which could be studied in solution at 0°. The upshot is that a mass of trustworthy data proves that soaps exhibit osmotic activity comparable with that of an ordinary crystalloid such as sugar.

This at once exposed a fundamental difficulty in interpreting the results according to any of the other hitherto recognised theories of physical chemistry. The conductivity is that of a highly dissociated salt, whereas the osmotic activity is scarcely equal to that of an undissociated crystalloid, and yet many years of work had been devoted to establishing the trustworthiness of each of these facts. Examination of the results of the concentrated solutions of the higher soaps showed that, whereas the conductivity corresponded to that of two good conducting ions, the osmotic pressure was only that of one ion altogether. In other words, the osmotic result proved that the only crystalloidal constituent of such a solution was the sodium or potassium ion, all the other constituents, including whatever accounted for quite half the conductivity, being colloidal.

Hence we are driven to the conclusion that there are present in these solutions colloidal particles, the "ionic micelle," possessing an actual conductivity often several times greater than that of the sum-total of the ions which are contained in it, and which in so aggregating have retained their electrical charges. These aggregates are so large that they have little or no osmotic effect. For suggestions that make plausible the properties and stability of such aggregates, reference must be made to papers published by the Royal Society and the London and American Chemical Societies, where also it is shown how these conceptions explain the various properties of soap solutions. Direct measurements are now being carried out to test even more directly the validity of the explanations here advanced.

For the sake of clearness it should be emphasised that conductivity is not identical with rate of movement in an electric field, for it is a remarkable fact that matter in all states of subdivision from single atomic ions up to coarse granules may move at roughly the same rate in an electric field. This movement (cataphoresis) in the case of a fine grain of sand might thus be equal in magnitude to that of one of the slower ions, whereas the resulting equivalent conductivity is only infinitesimal. The ionic micelle of soap solutions is noteworthy in that its mobility in an electrical field exceeds that of most true ions.

It is probable that quite general laws underlie the behaviour of colloidal particles together with all surfaces of separation in which ionising solvents are involved, thus including emulsions as well as large continuous surfaces.

In another respect, too, soap solutions afford a particularly good example for the study of a colloid in that the whole gamut of transition stages between ordinary salts and colloids can be illustrated by choosing the salts of the various fatty acids, or even by a mere change in concentration of a solution of any one of these. In dilute solution the soaps are largely present as simple salts, whereas in concentrated solutions of the higher soaps we have the complete formation of colloidal electrolyte.

Having gained some insight into the properties and behaviour of the slightly charged colloids and the highly charged colloidal electrolytes, the greatest need at the present time for the development of colloid chemistry is the discovery of some method of studying neutral uncharged colloids, such as, for instance, rubber or nitrocellulose solutions. No one has yet succeeded in developing a general method for obtaining quantitative data of direct significance, and a big advance is to be hoped for in this direction. This would probably lead to rational methods for the study of such familiar but complicated structures as the textiles, or paper, in which solvent is no longer present.

Recent study of soap solutions in the Bristol University laboratory has shown, further, that they can exist in three distinct characteristic forms—namely, clear, somewhat viscous, liquid sols, transparent elastic gels, and white opaque curds. Nearly all our previous knowledge of the properties of jellies has been due to the study of gelatin, usually containing admixed and partly combined salts or acids. The simpler case of the soap gels is, again, suited for study because no extraneous substances are present, and, as we have seen, the various constituents of the soap solution are characterised by well-marked properties such as conductivity and osmotic activity.

It has now been shown that the properties of soap solutions are independent of whether the solution is in the form of sol or gel except for the distinctive mechanical properties of the latter. In other words, the chemical equilibria, and hence the colloidal particles, are identical in sol and gel. This means that the gel structure must be built up of the same colloidal particles as were present in the sol. The possibilities as to the nature of this structure are severely limited by the fact that the conductivity remains unaltered. Hence we must infer that the colloidal particles are stuck together to form loose aggregates, which may be fragments of irregular network, or more probably innumerable filaments, which, being embedded in the solution, give to the whole its temporary rigidity and elasticity. Many other lines of evidence support this view. For instance, the optical evidence shows that the structural elements in the gel are of very fine colloidal dimensions, far below the powers of the microscope. This conclusion that the particles in sol and gel are identical in number and nature shows that nothing analogous to crystallisation has taken place.

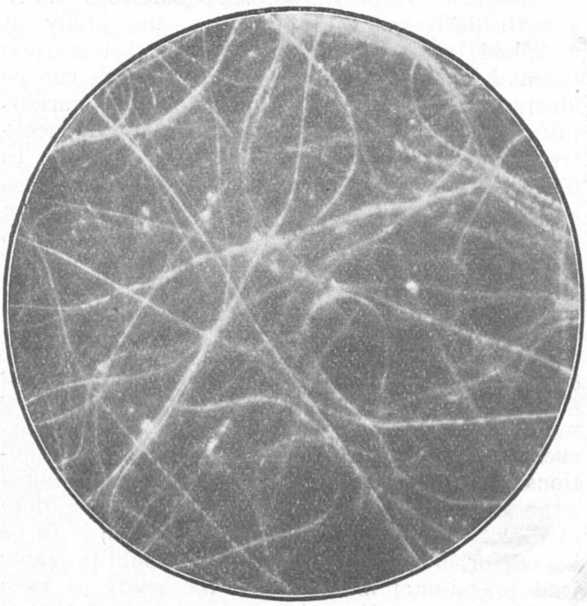

FIG. 1.—Ultramicroscopic appearance of a sodium soap (0·8*N* Sod. Myristate, × 600).

In clear contradistinction to this, curds and coagula are formed by a process closely analogous to crystallisation. Soap sols and gels show almost nothing in the ultramicroscope with its dark ground illumination, but when solidification to white curd begins white fibres of barely microscopic diameter are seen to shoot out until the whole becomes a dazzling white felt of these fine fibres. Fig. 1 (magnification 600) illustrates this appearance in a typical sodium soap, the myristate, in this its permanent stable state. To the naked eye it appears as a hard white cake of soap. Fig. 2, the stearate, exemplifies the more complicated behaviour of soft potassium soaps, in which the fibres that first appear are extremely short, and often twinned, but in which, on standing, true microscopic crystalline plates appear. These tiny crystals undoubtedly account for the "figging" which is seen in most good soft soaps.

Work at the Bristol University laboratory has

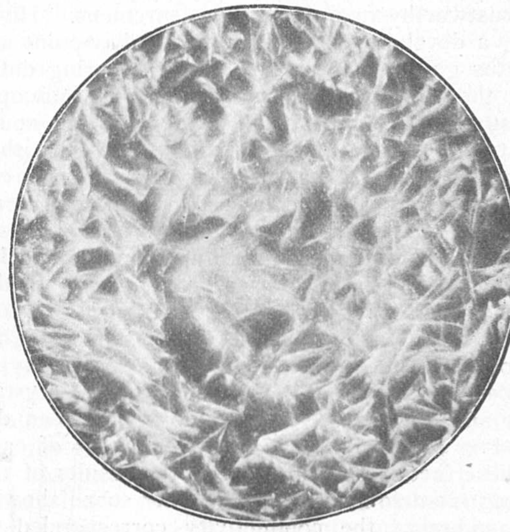

FIG. 2.—Ultramicroscopic appearance of a potassium soap (0·5*N* Pot. Stearate, × 500).

not been confined to the elucidation of the results here outlined, but an extensive programme of investigation of the colloid and phase-rule phenomena involved in the typical processes of soap boiling is in progress, in the expectation that the precise elucidation of the behaviour of this particularly suitable and characteristic material may lead to the better understanding of some of the typical problems of the physical chemistry of the colloidal state.

Inland Waterways.[1]

By DR. BRYSSON CUNNINGHAM.

THE outstanding feature of Mr. Minikin's book is the very interesting series of photographic illustrations which it contains; these impart a most effective realisation of the physical characteristics of the watercourses described in the text. They are a most serviceable adjunct, and some of the views have the additional charm of being picturesque. We reproduce two by way of example.

The work consists of ten chapters, of which the first is preliminary, and the second deals with general considerations relating to torrential phenomena, bends, valleys, and erosion, while chap. iii. is on rainfall. The available rainfall, or run-off, is said to vary between 20 per cent. on permeable soils and 75 per cent. on impermeable ground. As limits, these are perhaps somewhat wide, and might, in this country at any rate, be appreciably narrowed. From a survey of flood discharges in England and Wales it has been computed by Mr. Clayton that in average areas the run-off to the sea is between 50 and 60 per cent. of the total rainfall. Transpiration, as a source of absorption of rainfall, receives little notice. Chap. iv. deals with river surveys, and in particular describes methods applicable to running

1 "Practical River and Canal Engineering." By R. C. Royal Minikin. Pp. vii+123+12 plates. (London: Charles Griffin and Co., Ltd., 1920.) 12*s*. 6*d*.

surveys in unexplored or virgin tracts such as are to be found in Brazil, where the author has had much experience. For computing discharges, the well-known Chezy formula

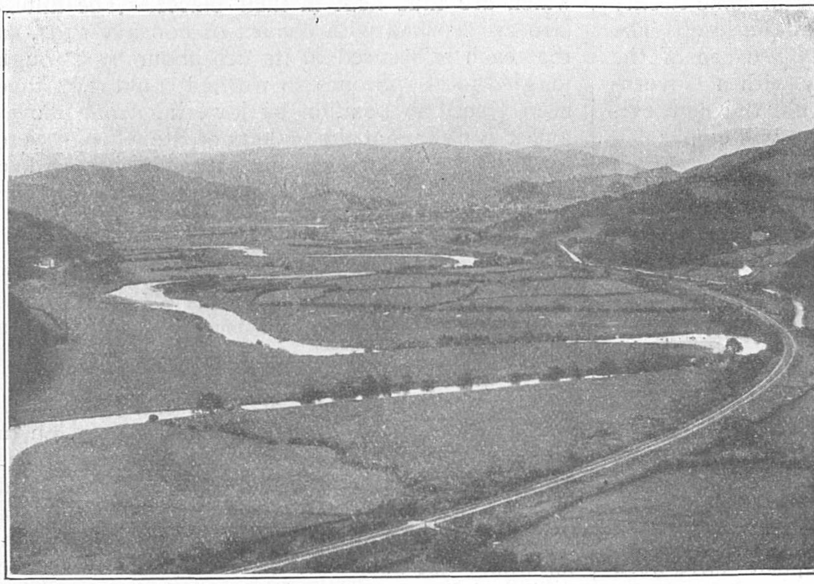

FIG. 1.—Dovey Valley, showing the river meandering from side to side of a broad, flat valley. From "Practical River and Canal Engineering."

is quoted, but there is no reference to the classic expression of Ganguillet and Kütter, or to the suggested adaptation of Chezy's formula in a very compact form, put forward by Mr. Barnes a few years ago. Chap. v. treats of waterways (watercourses would be a better term), which are classified as torrents, torrential rivers, semi-torrential rivers, and smooth flowing rivers. Chap. vi. deals with floods, chap. vii. with water flow, and the two following chapters with river training and canalisation. Canals are left to the last, and are compressed within the limits of a single chapter.

From the foregoing outline of the contents, and from the fact that the book contains only 119 pages of matter in fairly large sized print with numerous illustrations, it is evident that the treatment of the subject is necessarily general. Indeed, the author disclaims any attempt to include theoretical considerations in his purview. The explanation of so important a subject as canal construction within the compass of ten pages is obviously insufficient for completeness. As a brief review, however, the book has the merit of being clear and interesting, and the author's experiences in Brazil and elsewhere yield a number of practical hints of serviceable importance.

The startling incident recorded on p. 21 of the sudden invasion in clear weather of a trekking camp in Minas Geraes, Brazil, by a torrent from a downpour of rain on the hill summits some few miles away gives a vivid idea of the uncertainties and vagaries of rainfall in some districts. However, it is not necessary to seek an example so far away as Brazil; there was quite recently a disastrous instance of the same kind in Lincolnshire when the town of Louth was swept by a flood without any warning. The author dwells on the influence of vegetation in regard to its effect on rainfall, and says that in Brazil, as in other countries, great loss has been incurred through the careless cutting down of trees to make way for the farmer. He states that many extensive forests have disappeared within the last fifty years, due to the custom of burning down a wooded area to form new plantations as soon as the old, for lack of care, have become exhausted. He believes

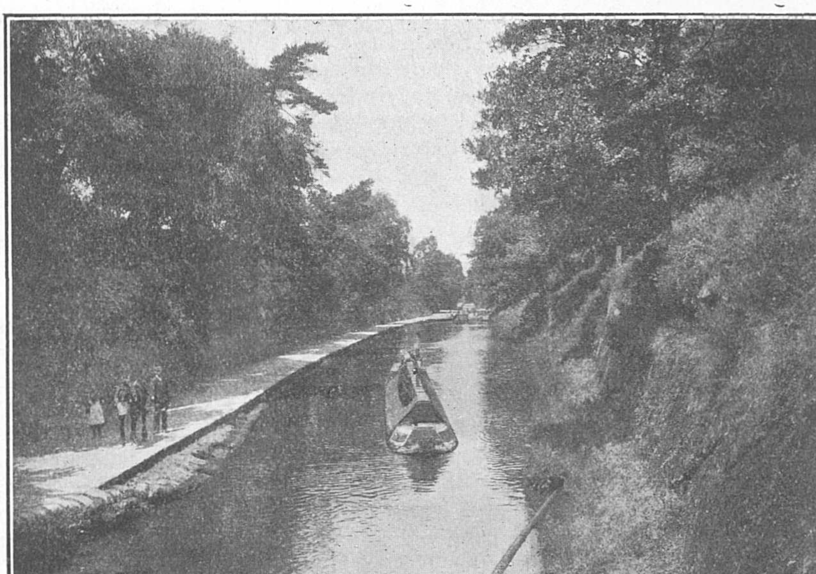

FIG. 2.—Canal in sandstone cutting. From "Practical River and Canal Engineering.

that the lack of rain upon several districts in Brazil is a direct consequence of this policy; this is an opinion which will, however, not command general acceptance.

Recent Work at Stonehenge.

THE repair of Stonehenge by the Office of Works has given occasion for the renewal of the excavations which were begun some twenty years ago by the Society of Antiquaries. The event is of good omen, not only because of the co-operation of a learned society with a Government Department, but also because the new evidence obtained by a season's work will emphasise the necessity of field-work in archæology. Much has been written about Stonehenge and our prehistoric monuments generally, but the past year has contributed more to our actual knowledge than all the theorists. The examination of the so-called Aubrey holes has demonstrated the former existence of a megalithic monument older than the Stonehenge of to-day. It consisted of a circle of standing stones, enclosed by a bank and a ditch, and seems to have been robbed of its stones, presumably for use in the present Stonehenge, during the period of the Bronze age in this country. Not long after the removal of the stones cremated human remains were placed in nearly all the holes in the chalk where the stones had stood. Similar deposits have been found in the ditch and elsewhere, and it will be well to suspend judgment on their meaning until the whole area has been thoroughly explored.

Meanwhile it seems that the last attempts to assign a date to Stonehenge should be reconsidered. The absence of any evidence that metal tools were used in its construction, and the deductions based on astronomical grounds, appeared to point to a date in the first half of the second millennium B.C. A more recent date is at least suggested by the late discoveries.

During the course of the work the use of modern cranes and jacks has inevitably suggested a comparison with the mechanical means possessed by the original builders. As is well known, there are tenons on the tops of the upright stones, fitting into mortises on the lintels, which are thus kept in their places. The lintels also are worked with convex or concave ends, so that each is secured to its neighbour by a rough joggled joint. Stones so worked could only have been placed in position by lowering from above, and it is clear that the makers of Stonehenge were equal to the task of raising stones weighing five or six tons, and in some cases far more, to the required heights, and of setting them on the uprights with absolute precision. The use of levers and inclined planes of earth gives no satisfactory explanation, and seems absolutely excluded on the evidence of one of the existing lintels. This shows an enlargement of the mortises along the length of the under-side of the stone, which can only be the correction of a miscalculation discovered when the lintel was being lowered on to the tenons. To make the necessary alteration the lintel must have been removed, and this could scarcely have been effected without the use of some form of rope and a method of slinging, such as would not be at the command of a primitive and uncivilised community.

As a megalithic monument Stonehenge is anything but primitive, and is, indeed, in a class by itself, so far as British monuments are concerned. Whether the excavations of the next few years will bring to light any convincing evidences of its origin and purpose time alone can show.

The question of the origin of the "blue stones" has been once more attempted, and Dr. H. H. Thomas, of the Geological Survey, has positively identified them with the formation at the Prescelly mountains in Pembrokeshire. This is an important addition to our knowledge, though the question of their transport to Stonehenge is not thereby solved.

Obituary.

AS we go to press we deeply regret to see the announcement that LORD MOULTON died during the night of March 8.

SIR FELIX SEMON, the well-known laryngologist, died on Tuesday, March 1, at his residence at Great Missenden, Bucks. Sir Felix was born at Danzig in 1849, and received his medical education at Heidelberg, Berlin—where he took the M.D. degree in 1873—and later in Vienna and Paris. He then moved to London, received an appointment as clinical assistant at the Throat Hospital in Golden Square in 1875, and rapidly became known as an expert on diseases of the throat. In 1885 he was elected a fellow of the Royal College of Physicians, and in 1893 he was one of the founders of the Laryngological Society, of which he was president for the years 1894–96. When Sir Felix retired from London in 1911 a sum of 1040*l*. was presented to him in recognition of his services to laryngology; this sum he presented to the University of London to establish the Semon Lecture Trust for the purpose of awarding a commemorative bronze medal for work on the treatment of diseases of the throat and nose, and to found the Semon Lectureship in Laryngology. Sir Felix received knighthood at the Diamond Jubilee in 1897, and was created K.C.V.O. in 1905. He was also the recipient of numerous foreign decorations, and was an honorary or corresponding member of many medical societies. Many articles from his pen have been published in medical journals and in the reports of scientific societies, but he will be best remembered as the founder and for twenty-five years the editor of the *Internationales Centralblatt für Laryngologie und Rhinologie*. His own work was chiefly in connection with cancer of the throat and with the functions and diseases of the motor nerves of the larynx.

WE regret to announce the death of SIR CHARLES ALEXANDER CAMERON on Sunday, February 27, at Dublin. Sir Charles was born in Dublin in 1830, and devoted most of his lifetime to the study of public health in his birthplace. He was a fellow of the Royal Colleges of Physicians and Surgeons of Ireland, of the latter of which he had been president, and he held a number of diplomas from various public health and sanitary institutions. From 1883–89 he was president of the Royal Institute of Public Health, and from 1893–94 he served as president of the Society of Public Analysts. Sir Charles was also a member of numerous foreign medical societies. For more than half a century he had control of the Public Health Department of Dublin Corporation, and had been public analyst for a large area round Dublin since 1862. In 1902 he was the recipient of the Harben gold medal. His publications afford a measure of the scope of his interests in science. The best known of his books is probably "The History of the Royal College of Surgeons of Ireland," the last edition of which was published in 1916. He was also the author of books on agricultural chemistry and stock-feeding, as well as of numerous works and papers dealing with public health and hygiene. He received knighthood in 1885, and was created C.B. in 1899.

THE death of MR. JAMES KEITH on February 23 is announced in *Engineering* for March 4. Mr. Keith was the founder and managing director of the firm of James Keith and Blackman, the well-known heating and ventilating engineers, and much of the apparatus manufactured by his firm was of his invention. He was an associate member of the Institution of Civil Engineers, and a member of the Institution of Mechanical Engineers; he was also the author of numerous publications and contributions to the technical Press. Mr. Keith gave expert evidence in 1897 at the Board of Trade inquiry into the ventilation of the London Underground Railways, and also in 1903–4 before the Select Committee of the House of Commons on the ventilation of the Houses of Parliament.

Notes.

PROF. A. S. EDDINGTON has been elected president of the Royal Astronomical Society in succession to Prof. A. Fowler.

AT the meeting of the Royal Society on May 5 the Croonian lecture will be delivered by Dr. Henry Head on "Release of Function in the Nervous System."

THE Principal Trustees of the British Museum have appointed Mr. C. Tate Regan to be keeper of zoology and Dr. G. F. Herbert Smith assistant secretary at the Natural History Museum, South Kensington; also Mr. Robert L. Hobson and Mr. Reginald A. Smith deputy keepers in the department of British and medieval antiquities.

THE Toronto correspondent of the *Times* announces that a report by a Committee of the Dominion Privy Council, approved by the Duke of Devonshire, the Governor-General, expresses to Mr. Vilhjalmur Stefansson "the thanks of the Government of Canada in recognition and appreciation of your distinguished services rendered to Canada in connection with your explorations in the Arctic regions."

THE Radio Research Board of the Department of Scientific and Industrial Research, 16 Old Queen Street, S.W.1, is requiring workers of high academic qualification for the purpose of undertaking research work in wireless telegraphy. The yearly remuneration offered is from 350*l.* to 550*l.* In making application for the positions candidates should give particulars of any papers published by them in scientific journals.

THE following were elected fellows of the Royal Society of Edinburgh at the ordinary meeting on March 7:—Dr. Nelson Annandale, Mr. W. Arthur, Mr. B. B. Baker, Dr. Archibald Barr, Mr. J. Bartholomew, Mr. A. Bruce, Mr. Andrew Campbell, Dr. Rasik Lal Datta, Dr. John Dougall, Dr. C. V. Drysdale, Mr. G. T. Forrest, Dr. W. Gibson, Dr. J. W. H. Harrison, Mr. J. A. G. Lamb, the Rev. A. E. Laurie, Mr. Neil M'Arthur, Mr. D. B. M'Quistan, Dr. T. M. MacRobert, Dr. J. M'Whan, Mr. J. Mathieson, Sir G. H. Pollard, Prof. E. B. Ross, the Right Hon. J. P. Smith, Prof. N. K. Smith, and Dr. I. S. Stewart.

AT a meeting of the Royal Dublin Society on February 22, the president, Lord Rathdonnell, in the chair, the Boyle medal of the society was awarded to Dr. George H. Pethybridge. In recommending Dr. Pethybridge's name as that of a suitable recipient of the Boyle medal, the science committee of the Royal Dublin Society directed special attention to his researches in the elucidation of the life-history of the fungi which cause blight in potatoes, and to his discovery of a process in the development of the sexual organs of *Phytophthora erythroseptica*, Pethy., and of *P. infestans*, Mont., until then unknown.

THE Geological Survey has just issued vol. xiv. of its Special Reports on the Mineral Resources of Great Britain, this being devoted to a description of the fireclays; it thus forms a companion volume to vol. vi., in which the other refractory materials such as ganister, etc., are described, and there is naturally a certain amount of overlapping between these two. The present report deals with the geology of the fireclays, and particularly with the available reserves of this material; it is intended that the chemistry of the subject should be dealt with in a separate volume, upon which Dr. J. W. Mellor is at present engaged. This is the first time that any serious attempt has been made to collect information upon this subject, the economic importance of which is very great, having regard to the fact that high-grade refractory materials are indispensable to so many of our key industries.

THE following are the lecture arrangements at the Royal Institution after Easter:—Prof. R. A. Sampson on (1) The Nebular Hypothesis and (2) Measurement of Starlight; Prof. Keith, four lectures on Darwin's Theory of Man's Origin; Mr. Clodd on Occultism; Sir James Frazer on (1) Roman Life (Time of Pliny the Younger) and (2) London Life (Time of Addison); Dr. C. T. R. Wilson on Thunderstorms (the Tyndall lectures); Mr. H. S. Foxwell on Nationalisation and Bureaucracy; Dr. C. S. Myers on Psychological Studies: (1) Localisation of Sound and (2) Appreciation of Music; Mr. D. S. MacColl on War Graves and Monuments; Sir Alexander Mackenzie on Beethoven; Dr. H. H. Dale on Poisons and Antidotes; Mr. M. Y. Oldham on The Great Epoch of Exploration: (1) Portugal and (2) Spain; Prof. E. C. C. Baly on Chemical Reaction; Mr. F. Legge on Gnosticism and the Science of Religions; and Dr. R. S. Rait on (1) Scotland and France and (2) Scott and Shakespeare. The Friday evening meetings will be resumed on April 8, when Dr. R. H. A. Plimmer will deliver a discourse on Quality of Protein in Nutrition. Succeeding discourses will probably be given by Mr. Ernest Law, Sir J. J. Thomson, Sir James Walker, Sir Frank Dyson, Sir Robert Robertson, Dr. Bateson, Prof. Starling, Mr. A. Mallock, Dr. Leonard Huxley, and Dr. A. G. Webster.

AMONG the centenaries which fall due this year is that of Sir Richard F. Burton, the Oriental scholar and explorer, who was born on March 19, 1821. To the enterprise and daring which characterised Burton's travels in many unexplored parts of the world were added unusual powers of observation and a passion for scholarly research which together made him one of the most successful explorers of the nineteenth century. Practically all his numerous volumes remain standard works on the lands with which they deal. Among Burton's most striking exploits were his pilgrimage in disguise to Mecca and Medina in 1853–54 and his successful journey in 1855 to Harar, the forbidden city of Abyssinia, which several explorers had tried in vain to reach. In 1858 the expedition which Burton led to Central Africa in company with Speke discovered Lakes Tanganyika and Victoria, and so laid the foundations of modern knowledge of the sources of the Nile. Later work included important explorations in the Cameroons, the Gold Coast, Dahomey, and the Congo, and travels in the Rockies, Brazil, and Iceland. In addition to his geographical and anthropological volumes, Burton published a translation, with copious notes, of "The Arabian Nights."

IN the House of Lords on March 2 Lord Sudeley moved a resolution requesting the Government to take immediate steps to extend the employment of guide-lecturers and the sale of pictorial illustrations to all museums and similar institutions which are under Government control or influence. By this combination Lord Sudeley escapes the charge of asking only for fresh expenditure. The lecturers, it is true, cost money, but the postcards and similar reproductions make money. That has been the experience of the British Museum at Bloomsbury, and we have long wondered why the sale of postcards and photographs has not been taken up by the Natural History Departments at South Kensington. In the debate initiated by Lord Sudeley a year ago the Primate suggested that the system might be extended to provincial museums. Some, like Colchester, already issue postcards; others would doubtless be glad to utilise the experience of the Clarendon Press and the British Museum authorities. The profits, as Lord Sudeley suggested, might help to pay for the guide-lecturers. A pooling of funds under some central organisation might provide lecturers each of whom could deal with a limited geographical group of the smaller museums.

THE annual general meeting of the Chemical Society will be held at Burlington House on Thursday, March 17, at 4 p.m., when the result of the ballot for the election of council will be announced and the retiring president, Sir James J. Dobbie, will deliver his presidential address. The presentation of the Longstaff medal to Prof. J. F. Thorpe will also be made. At the anniversary dinner of the society, to be held at the Hotel Cecil, Strand, on the same day at 7 for 7.30 p.m., the past-presidents who have completed their jubilee as fellows of the society have been invited as guests of honour. Sir James Dewar, who was elected on December 1, 1870, and served as president from 1897–99; Sir Edward Thorpe, elected on February 16, 1871, and served as president from 1899–1901; and Sir W. A. Tilden, elected on June 1, 1865, and served as president from 1903–5, have accepted invitations to be present. At the first banquet given on November 11, 1898, during the presidency of Sir James Dewar, to those past-presidents who had been fellows for fifty years, the society entertained Sir Joseph Gilbert, Sir Edward Frankland, Prof. William Odling, Sir Frederick Abel, Prof. A. W. Williamson, and Dr. John Hall Gladstone; whilst a later banquet was held on November 11, 1910, under the presidency of Prof. H. B. Dixon, in honour of Sir Henry Roscoe, Sir William Crookes, Dr. Hugo Müller, Dr. A. G. Vernon Harcourt, and Prof. William Odling, who had completed their jubilee as fellows.

THE route to Mount Everest is discussed in the *Geographical Journal* for February by Lt.-Col. C. H. Bury, who has been appointed chief of the projected expedition. Col. Bury favours the route from Darjeeling over the Jelep La Pass to Phari, and then *via* the Chumbi Valley, Kampa Dzong, and Tingri Dzong to the northern side of Mount Everest. The direct and shorter road to Kampa Dzong *via* Gangtok and the Tista Valley is more difficult for pack-animals, for it traverses in the Tista Valley a region of heavy rainfall where leeches abound. The route *via* Jelep La is now the main trade route into Tibet, and is traversed constantly by numbers of mules and pack-ponies. From Kampa Dzong to Tingri Dzong Col. Bury foresees no difficulties, and estimates that the journey should take about seven days in broad valleys about 15,000 ft. above sea-level. No advantage seems likely to be gained by making use of the southern approach to Mount Everest by the Arun Valley, even if the Nepal Government gave consent. Col. Bury considers that aeroplanes would be useless in Tibet on account of the low density of the atmosphere, which would make it impossible for the present type of machine to rise off the ground. For general transport purposes he advocates yaks, which are very sure-footed and can be used up to altitudes of 20,000 ft. The *Geographical Journal* announces that official news of the expedition will be given solely through the Royal Geographical Society and the Alpine Club.

IN the report of the Corresponding Societies Committee of the British Association for this year, a welcome change of policy is inaugurated in regard to the list of papers which the committee publishes annually. Hitherto this bibliography has been limited to papers appearing in the publications of societies affiliated to this committee. In that form it was incomplete, contained much that was of no value whatever, and was of little or no use to serious workers. By a judicious weeding-out of all subjects which are adequately dealt with in other bibliographies or by other societies, the list of papers this year has been confined to those dealing with the zoology, botany, and prehistoric archæology of the British Isles. By extending its scope to include every British publication, whether of an affiliated society or not, the bibliography aims at a complete record of the work done in these subjects in this country. In its revised form the bibliography will be of immense service to those engaged in faunistic work and regional surveys. It covers the period from June to December, 1919, and appears to be remarkably complete. Only two omissions were detected in a list of more than a hundred references to the fauna of a particular district. The *Field* and *Country Life* are not included in the journals catalogued; perhaps they are regarded as newspapers, and therefore not within the scope of scientific journals. They, however, frequently contain records of great value, and every worker on British natural history has of necessity to search their pages for past records. The bibliography could be made more useful by a more detailed indication of the scope of each paper. For instance, all papers dealing with birds could be prefixed by the letter O instead of Z, and a similar distinctive letter could be arranged for all groups of animals and plants. Mr. T. Sheppard, the compiler, is to be congratulated on a useful piece of work, and thanked for the care and completeness with which it has been done.

DR. JAMES RITCHIE in the January–February issue of the *Scottish Naturalist* begins a survey of the occurrence of the walrus in northern Scotland. He shows that the modern walrus (*Trichechus rosmarus*) is a post-Glacial species which in prehistoric times ranged in British seas far south of its present haunts, while up to the middle of the sixteenth century it was evidently abundant in the Orkneys, where it was extensively hunted for the sake of its ivory, oil, and skin. Its extinction as a resident species was no doubt due, as in other parts of the world, to indiscriminate slaughter for economic purposes.

THE common fox introduced into Australia somewhere about 1860 has for many years been a pest, but, according to an article by Mr. G. A. Keartland in the *Victorian Naturalist* for December last, the thousands annually slain and thrown away are to become a source of revenue; no fewer than 150,000 skins have already been disposed of in the fur market. The author is, however, mistaken in believing that in Europe this animal produces no more than two at a birth, and he is also mistaken in supposing that the hare in Great Britain produces no more than one young in a year. Thus his contention that these two animals have become more prolific in Australia is not justified.

DR. A. E. BARCLAY in the *Archives of Radiology and Electrotherapy* (No. 246, January, 1921, p. 225) indicates a danger arising from the Coolidge tube when used for X-ray screen work. Secondary radiation emanates from the anticathode, and the secondary image may pass through the screening diaphragm used; it is widely dispersed and produces undesirable effects. The recognition of this secondary radiation is of very great importance to the safety of the worker. The danger can be rectified by inverting the tube or by providing a hood for the anticathode.

AN interesting article on bacteriology in relation to commercial meat products appears in the *New Zealand Journal of Science and Technology* for November (vol. iii., No. 4), in which Mr. A. M. Wright describes the process of meat canning and the causes of failure. Frozen meat is also discussed, and an interesting experiment on the preservative action of cold described. A tub of water was inoculated with many millions of putrefactive bacteria, pieces of meat were immersed in it, and the tub was then placed in a freezing chamber and kept for five months at -15°–20° C. At the end of this time the meat was examined; it was perfectly sweet and fresh, and sections showed no invasion of the meat by the putrefactive organisms.

Medical Science: Abstracts and Reviews for February (vol. iii., No. 5) contains, among other articles, summaries of recent work upon the radiological treatment of malignant disease, botulism, and epidemic hiccough. Botulism is a condition due to the ingestion of food containing poisons elaborated by an anaerobic bacillus, *B. botulinus*. Several outbreaks of botulism have occurred of late in the United States in connection with canned vegetable products, *e.g.* olives, asparagus, and beetroot. At Kiel an epidemic occurred from the consumption of pickled herrings. No outbreaks have been recorded in this country, but it is of interest to recall that the first cases of encephalitis lethargica occurring in 1918 were mistaken for it. Epidemic hiccough has been prevalent in France during this winter, and several French physicians believe that it is a manifestation of encephalitis lethargica.

WE have received part 12 (pp. 351–496) of the second volume of a recently established South American journal, *Physis*, which is the organ of the Argentine Society of Natural Sciences. It is well printed and illustrated, and is evidently a journal which cannot be overlooked by European students. The three most important articles in the part before us are by

F. Santschi on South American ants, by G. Bonarelli on the human mandibles of Bañolas, and by J. Brèthes on the South American bees of the genus Xylocopa, Latr. It may be added that two out of three of the above papers are written in French.

THE presidential address delivered by Comdr. J. J. Walker before the Entomological Society on January 19 dealt with "Some Aspects of Insect Life in New Zealand." It contains interesting information useful to the student of geographical distribution. As the author points out, the noble forests of the two islands are now little more than memories, and more than 350 species of introduced trees, shrubs, and weeds are ousting what is left of the indigenous flora. It is also a matter of certainty that the exceptional fauna of New Zealand is to a great extent doomed to extinction, and no effort should be lost to acquire as much information as possible concerning the animal life before the latter also is a thing of the past. Comdr. Walker comments on the very general opinion that New Zealand possesses the most limited insect fauna of any land of the same extent. He attributes this belief to the nocturnal or unobtrusive habits of many species, a large number being either inactive or retiring; many are cryptically coloured and hard to detect, and others very local. About 4000 species of Coleoptera are known, but the Cetoniadæ and Cassididæ are absent. More than 1000 species of Lepidoptera inhabit New Zealand, and all except about 70 are indigenous. The butterflies, however, are very poorly represented, only 15 species being recorded. Diptera are abundant, but Hemiptera and Hymenoptera are comparatively few.

DURING the meeting of the Science Masters' Association at Oxford on January 5 and 6, some interesting demonstrations (with exhibits) were given by Mr. T. V. Barker in the mineralogical department of the University Museum on the subject of the study of crystals in schools, and a pamphlet of "Practical Suggestions" has been drawn up embodying the main facts dealt with. It is designed to amplify a previous pamphlet which was noticed in NATURE of September 2 last, p. 28. The preparation of solutions for crystallisation, instructions for the screen-projection of the crystals grown, the nature of crystals, isomorphism, polymorphism, and crystal structure as revealed by simple measurements were a few of the subjects dealt with in an attractive manner. As an example of the style adopted, a few lines from the reference to the isomorphism of the two acid phosphates of potassium and ammonium may be quoted:—"When the pupil has observed and measured both substances [under the microscope], he will agree with Mitscherlich that the two forms are isomorphous in the literal sense; and if some two years later he came to measure them with the reflecting goniometer he would, like Mitscherlich, revise his opinion and conclude that they are closely similar, but not identical, in angles."

THE variations of "mean sea-level" on the Flemish coast have been analysed by Dr. Bruno Schulz and the results published by the Deutsche Seewarte (*Aerologische und Hydrographische Beobachtungen den Deutschen Marine-Stationen während der Kriegszeit*, 1914–18, Heft 1). Owing to war conditions full weather information was lacking, and the paper is chiefly concerned with long-period oscillations and with the correlation between non-periodic variations and local wind. Formulæ are given as representing these effects. It is interesting to note that it was impossible to use as data the difference between observed and predicted tides owing to the obvious errors of the latter, and daily means of hourly heights were used in conjunction with monthly and annual means. The wind effects are sorted according to direction and strength. The best results are found to be given by comparing the tidal height at a given time with the wind about three hours earlier. After allowing for wind there is a residual effect attributed to air-pressure; the ratio between simultaneous changes in sea-level and in barometer is found to have an average value of 10·3, the statical value being 13·4. Apparently the long-period oscillations, wind effects, and air-pressure effects are treated as being quite independent. There is great need for further work on these important problems, especially in this country.

IN his presidential address to the Optical Society on February 10 Mr. Robert S. Whipple emphasised the influence of the design of scientific instruments on their accuracy, sensitivity, and cost of production. An instrument may be rendered ineffective by bad design of the moving parts, by unsuitability of the materials employed, or by bad workmanship. The selection of the materials, however, is part of the design, and good design will often minimise the effect of bad workmanship, though the converse is not true. A consideration of the fundamental principles of instrument construction shows the advantages of the geometric form of design. By geometric design internal strain in the parts of an instrument can be greatly reduced and backlash between the different parts eliminated. Geometric design may also simplify construction and thus materially reduce the cost of manufacture. The new applications of research to industry in many cases involve the new application of an old instrument. Thus the research instrument of to-day becomes the tool of to-morrow. In designing an instrument the manufacturer should, therefore, always have in mind the possibility of quantity production, so that the instrument can be readily developed from its laboratory form to one suitable for the workshop and capable of being manufactured on a large scale. Cheap production is thus rendered possible, and this is an important factor, especially in view of the keen competition which the scientific instrument industry of this country has now to meet.

PART II. of the Transactions of the Institution of Engineers and Shipbuilders in Scotland contains a paper by Prof. A. L. Mellanby and W. Kerr on pressure-flow experiments on steam nozzles. This paper is the second of a series on the same subject, the preceding paper having been presented to the British Association in August last. The measurements of pressure were carried out by means of a search-tube, which, when moved along the jet, gave the pressure at any chosen position. The search-tube has already given excellent results in the hands of Prof. Stodola, but the method of analysis adopted in the present series is believed to be new. The results are exhibited in the form of curves, and the following are some of the author's deductions:—The purely convergent form of nozzle operates very much in accordance with theoretical ideas; it has a smooth expansion line in agreement with its well-rounded form, and a maximum range approximately in line with the theoretical critical drop. The convergent-parallel type scarcely acts in keeping with preconceived ideas; this form of nozzle should be considered one of extended convergence only. In both the above types theory demands a maximum range limited to a pressure ratio of 0·55; the actual ranges have only rough agreement with this figure. The convergent-divergent type has one over-all range in which the fall of pressure is continuous, but the throat pressure seems always to be below the theoretical. Sharp-entranced nozzles were also experimented with.

WITH reference to the letter published in NATURE of February 3 discussing coloured thinking and thought-forms, Mr. G. Stridsberg, of Stockholm, wishes to direct attention to a communication by Prof. H. Mygind, of Copenhagen, which appeared in the Danish review *Tilskueren* for 1884 (pp. 361–78) entitled "Om Erinring og Fantasi aforistiske Betragtninger" ("Aphorisms on Memory and Imagination").

A LENGTHY catalogue (No. 197) of scientific books and publications of learned societies, consisting of upwards of 2000 items, has reached us from Messrs. W. Heffer and Sons, Ltd., Cambridge. As will be seen by the following table of contents, it contains titles of works in most of the sciences. It should therefore appeal to many readers of NATURE, who can obtain the catalogue upon request. The list is classified as follows:—Mathematics, Physics, Astronomy, and Early Philosophy; Engineering; Agriculture, Husbandry, and Farriery; Anthropology and Ethnology; Botany; Chemistry, Chemical Technology, and Metallurgy; Geology, Mineralogy, and Palæontology; Zoology and Biology; Physiology, Anatomy, and Medicine; Portraits of Men of Science; Psychology and Psycho-Analysis; and Addenda.

A CATALOGUE (No. 410) of antiquarian and bibliographic interest has just been issued by Mr. F. Edwards, 83 High Street, Marylebone, W.1. It gives particulars of some 300 books, maps, plans, and engravings relating to London and its vicinity, and will be sent free upon application.

THE Smithsonian Institution issues a classified list of its publications available for distribution to scientific workers either gratis or at the prices indicated. Publications of the United States National Museum and of the Bureau of American Ethnology are not included. The list before us, which is Publication 2585, is brought down to August 21, 1920.

Our Astronomical Column.

LARGE METEORS ON MARCH 1 AND 2.—Mr. W. F. Denning, of Bristol, writes:—"On the evening of Tuesday, March 1, two large meteors were observed, and on the following night three others were recorded. The most brilliant of them all appeared on March 2, at 10 p.m. It was seen at Bristol, at Dunton Green, Kent, at Holt, Norfolk, and at other places. It was a very fine object, and gave a flash which lit up the sky. Its radiant point was a few degrees east of δ Leonis, and the path of the meteor was over the English Channel approximately from Dieppe, France, towards the Isle of Wight, but reaching only about half that distance. Observations are still coming to hand, and the real path will be calculated from them. It has been several times pointed out that the first few nights of March are specially distinguished by apparitions of bright meteors, although no periodic shower is known to occur on those dates. There appear, however, to be several fairly active displays in progress, and from the evidence obtained this year we may be enabled to determine their radiant points accurately."

PONS-WINNECKE'S COMET.—This comet has not yet been detected—which is a matter for surprise. In 1915 it was photographed five months before perihelion, and it should now be within the reach of moderate instruments, especially as it is very favourably placed in the morning sky. The following elements are likely to be near the truth:—ω 174°, ☊ 96°, *i* 19·5°, *q* 1·01, log *a* 0·509, *e* 0·687. The most uncertain element is the date of perihelion. The following ephemerides for Greenwich midnight are based on the assumed dates:—1921 June 13·5 and June 21·5. The uncertainty is considerably greater than eight days, so the search should extend beyond the limits of the ephemerides; these, however, should define the line on which it lies with tolerable precision:

T = 1921 *June* 13·5.

	R.A. h. m. s.	N. Decl. ° ′	log *r*	log Δ
March 7	14 47 44	25 58	0·2126	9·9291
15	15 1 16	28 42	0·1932	9·8785
23	15 15 48	31 39	0·1729	9·8269
31	15 30 23	34 51	0·1519	9·7731

T = 1921 *June* 21·5.

	R.A. h. m. s.	N. Decl. ° ′	log *r*	log Δ
March 7	14 13 18	29 31	0·2317	9·9453
15	14 21 12	32 35	0·2126	9·8984
23	14 27 8	35 58	0·1932	9·8522
31	14 32 23	39 26	0·1729	9·8064

The search should be carried on assiduously up to March 20, after which the moon will interfere.

TWO NEBULÆ WITH UNPARALLELED VELOCITIES.—Prof. V. M. Slipher announces that the spiral nebulæ N.G.C. 584 (R.A. 1h. 27·3m., declination −7° 16′) and N.G.C. 936 (R.A. 2h. 23m., declination −1° 33′) have extremely high recessional velocities, which are 1800 and 1300 km./sec. respectively. There is a decided preponderance of recessional motion indicated for the spiral nebulæ.

Prof. Eddington ("Report on the Relativity Theory of Gravitation," p. 89) suggested that these high velocities may not be real, but a result of the curvature of space in Einstein's system, according to which very distant objects would have their spectral lines shifted towards the red.

The Chicago Meeting of the American Association.

THE annual meeting of the American Association for the Advancement of Science and of the scientific societies associated with it, which was held in Chicago from December 27, 1920, to January 1, was the seventy-third meeting of the Association. The attendance was very large, more than 2400 persons being registered, and the programmes were correspondingly full and of broad scope. Fourteen Sections of the Association met on this occasion, together with forty-one national scientific societies. The official general programme required 112 pages. The meeting was very successful in every way, reflecting the marked renewal of scientific activity that has followed the war. The American Central West was, naturally, most strongly represented at this meeting. Thirteen hundred and eighty-three members were registered, of whom 856 were from Illinois, 98 from Indiana, 121 from Ohio, 125 from Michigan, 181 from Wisconsin, 72 from Minnesota, 90 from Iowa, and 70 from Missouri. On the other hand, the attendance was of wide geographic distribution; there were 27 registrants from California, 5 from Washington, 7 from Arizona, 22 from Colorado, 50 from Massachusetts, 81 from the District of Columbia, 4 from Florida, 48 from Canada, 10 from the Philippine Islands, and 20 from China.

The address of the retiring president, Dr. Simon Flexner, director of the laboratories of the Rockefeller Institute for Medical Research, on "Twenty-five Years of Bacteriology" (*Science*, December 31, 1920) gave to the 713 persons who attended the opening session a clear and inspiring presentation of this very important subject from one who has been a leader in the progress of bacteriological science. Dr. L. O. Howard, Chief of the Bureau of Entomology of the United States Department of Agriculture, presided at the meeting as president-elect. The Association has benefited immeasurably by Dr. Howard's enthusiasm and skill as permanent secretary during the last twenty-two years. The roll of the Association is now about nine times as great as it was when he became the chief executive officer.

The various sessions were held mainly in the buildings of the University of Chicago, which are admirably suited for such gatherings. The local arrangements for the meeting, to which its marked success was due in the main, were in charge of the local committee for the Chicago meeting. The *personnel* of this committee was as follows:—J. Paul Goode, general chairman; Gilbert A. Bliss, publicity; Henry C. Cowles, membership; Henry G. Gale, meeting-places; Frank R. Lillie, finance; and William D. MacMillan, hotel accommodations.

The printing of the general programme—a very difficult task on account of the very limited time available after the manuscript was in hand—was accomplished with a very high degree of efficiency by the University of Chicago Press. The final editing and proof-reading was in charge of Dr. Goode, who, together with the other members of the local committee, served the Association at great self-sacrifice during the trying days just preceding and during the meeting.

Besides the opening session, there were two other sessions of general interest. At one of these Dr. Robert F. Griggs gave a beautifully illustrated lecture on the region of Mount Katmai, Alaska, and "the Valley of Ten Thousand Smokes." At the other of these sessions Prof. Robert W. Wood gave a lecture on "High-power Fluorescence and Phosphorescence," with ingenious and spectacular experimental demonstrations. The attendance at these two sessions was 519 and 710 respectively. Admission to the opening session and to these "general interest" sessions was by ticket, a set of tickets being given to each registrant. By this new feature it became possible to determine the attendance and to show its distribution among members, guests, students in the University, etc.

A visible directory of those registering, kept currently corrected by several typists and attendants, proved to be a generally appreciated feature of the Chicago meeting. Panels bearing the directory slips were hung along a wall of the registration-room, so that the directory was readily consulted by everyone.

Prof. E. H. Moore, of the University of Chicago, was elected president of the Association for 1921. He will preside at the Toronto meeting next December, and will give his address as retiring president at the Boston meeting a year later. Prof. Moore is the acknowledged leader of American mathematicians, and the Association is particularly fortunate in having for its president a man of such wide interests and great accomplishments, and one representing the branch of science that is fundamental to all others as is mathematics.

Dr. D. T. McDougal, director of the department of botanical research of the Carnegie Institution of Washington, was elected general secretary of the Association in succession to Prof. E. L. Nichols, of Cornell University. Dr. MacDougal has already been active in the organisation of the Association's work, especially in the Pacific and South-Western Divisions, and his election as general secretary is especially fortunate. This officer is constitutionally entrusted with the various aspects of general organisation, particularly with reference to the affiliation of scientific societies. The Association aims to become an affiliation of all the larger and more influential societies of America, and with the progress of this kind of affiliation the Association becomes the only organisation through which the influence of all these societies may be united for the advancement of science as a whole.

Another step that will increase the efficiency of the work of the Association was the authorisation of the appointment of an assistant secretary, to assist the permanent secretary in the scientific work of his office, as he has thus far been assisted in the clerical management of his office by the efficient executive assistant, Mr. Sam Woodley. Dr. Sam F. Trelease, of the Johns Hopkins University, who is conveniently located to devote part time to this work, has been appointed secretary. He has recently returned to the United States after several years of excellent service in the school of agriculture of the University of the Philippines at Los Baños, P.I.

One of the main concrete projects before the permanent secretary's office for the ensuing months is the publication of the summarised proceedings for the years 1916–21, together with the revised membership list of the Association. It is hoped to publish this volume in the early spring, and it is to be sold by subscription, payment being made in advance of publication. The price is 1.50 dollars to members and 2 dollars to others, and orders should be addressed to the permanent secretary's office in the Smithsonian Institution, Washington, D.C.

The Toronto meeting of the Association will be held from Tuesday, December 27, to Saturday, December 31 next. The opening session, at which Dr. Howard will deliver an address as retiring president, will be on the evening of Tuesday, December 27. The annual meeting for 1922–23 will be held in Boston, and that for 1923–24 in Cincinnati. The next quadrennial convocation meeting will occur in Washington, D.C., for 1924-25.

Dr. Burton E. Livingston, director of the laboratory of plant physiology of the Johns Hopkins University, who has been permanent secretary of the Association since last February, was re-elected permanent secretary for a period of four years. Dr. R. S. Woodward was re-elected treasurer of the Association, also for a four-year period.

The following vice-presidents and secretaries were elected for the respective Sections of the Association: *President:* Eliakim H. Moore, University of Chicago, Chicago, Ill. (one year). *Retiring President:* L. O. Howard, Bureau of Entomology, United States Department of Agriculture, Washington, D.C. *Permanent Secretary:* Burton E. Livingston, Johns Hopkins University, Baltimore, Md. (four years). *General Secretary:* D. T. MacDougal, Desert Laboratory, Tucson, Ariz. (four years). *Treasurer:* R. S. Woodward, Washington, D.C. (four years).

Chairmen and Secretaries of Sections (Chairmen to hold Office for One Year, Secretaries for Four Years).

Section A, Mathematics:—*Chairman:* Oswald Veblen, Princeton University, Princeton, N.J. *Secretary:* William H. Roever, Washington University, St. Louis, Mo.

Section B, Physics:—*Chairman:* G. W. Stewart, State University of Iowa, Iowa City, Iowa. *Secretary:* S. R. Williams, Oberlin College, Oberlin, Ohio.

Section C, Chemistry:—*Chairman:* W. D. Harkins, University of Chicago, Chicago, Ill. *Secretary:* Gerald L. Wendt, University of Chicago, Chicago, Ill.

Section D, Astronomy:—*Chairman:* S. A. Mitchell, University of Virginia, Charlottesville, Va. *Secretary:* F. R. Moulton, University of Chicago, Chicago, Ill.

Section E, Geology and Geography:—*Chairman:* Willet G. Miller, Bureau of Mines, Toronto, Canada. *Secretary:* Elwood S. Moore, Pennsylvania State College, State College, Pa.

Section F, Zoology:—*Chairman:* C. A. Kofoid, University of California, Berkeley, California. *Secretary:* H. W. Rand, Harvard University, Cambridge, Mass.

Section G, Botany:—*Chairman:* Mel. T. Cook, New Jersey Agricultural Experiment Station, New Brunswick, N.J. *Secretary:* Robert B. Wylie, Iowa State University, Iowa City, Iowa.

Section H, Anthropology:—*Chairman:* A. E. Jenks, University of Minnesota, Minneapolis, Minn. *Secretary:* E. A. Hooton, Peabody Museum, Cambridge, Mass.

Section I, Psychology:—*Chairman:* E. A. Bott, University of Toronto, Toronto, Canada. *Secretary:* Frank N. Freeman, University of Chicago, Chicago, Ill.

Section K, Social and Economic Sciences:—*Chairman:* No election. *Secretary:* Seymour C. Loomis, 82 Church Street, New Haven, Conn.

Section O, Agriculture:—*Chairman:* Jacob G. Lipman, New Jersey Agricultural Experiment Station, New Brunswick, N.J. *Secretary:* Percy E. Brown, Iowa State College, Ames, Iowa.

Section Q, Education:—*Chairman:* Guy M. Whipple, University of Michigan, Ann Arbor, Mich. *Secretary:* Bird T. Baldwin, Iowa Child Welfare Research Station, State University of Iowa, Iowa City, Iowa.

There were no elections in Sections L, M, N, and P.

The eight elected members of the council of the Association for 1921 are as follows, their terms of office to expire at the end of the annual meeting (denoted in parentheses):—N. L. Britton (1921-22), New York Botanical Garden; J. McK. Cattell (1921-22), Garrison, N.Y.; Henry C. Cowles (1921-22), University of Chicago; J. C. Merriam (1921-22), Carnegie Institution of Washington; G. A. Miller (1922-23), University of Illinois; W. E. Ritter (1922-23), Scripps Institution, La Jolla, California; A. E. Douglass (1923-24), University of Arizona; and Henry B. Ward (1923-24), University of Illinois.

The Council also includes the president, the permanent and the general secretary, the vice-presidents for the Sections, the secretaries of the Sections, and the representatives of the affiliated societies.

The executive committee of the council for 1921 consists of the following members, their terms of office to expire at the end of the annual meeting (denoted in parentheses):—J. McK. Cattell (1922-23), H. L. Fairchild (1923-24), Simon Flexner (1921-22), L. O. Howard (1924-25), W. J. Humphreys (1921-22), Burton E. Livingston (1924-25), D. T. MacDougal (1924-25), E. H. Moore (1921-22), Arthur A. Noyes (1923-24), Herbert Osborn (1924-25), and Henry B. Ward (1922-23).

The collection of portraits and autograph letters of all the presidents of the American Association made by Dr. Marcus Benjamin, of the Smithsonian Institution, has been purchased by the Association under conditions representing a partial gift from Dr. Benjamin.

The sum of 5000 dollars was appropriated for the Committee on Grants for Research, to be distributed during 1921.

A resolution was adopted by the council as follows:—

"*Be it Resolved:* That the American Association for the Advancement of Science would welcome the organisation of Mexican men of science and their affiliation with this Association. *Resolved:* That a committee of seven be appointed to co-operate with such organisation as Mexican men of science may form."

The following were appointed on this committee:—L. O. Howard (chairman), A. E. Douglass, E. L. Hewitt, D. S. Hill, W. J. Humphreys, D. T. MacDougall, and W. Lindgren.

The following three resolutions were also adopted by the council:—

"Whereas the American Association for the Advancement of Science includes Sections on Physiology, Experimental Medicine, and Zoology, and whereas advancement of knowledge in these sciences, which is dependent upon intensive study of living tissue, is inevitably followed not only by amelioration of human suffering, but also by a lessening of animal disease and by substantial economic gain and by conservation of the food-supply; and whereas this Association is convinced that the rights of animals are adequately safeguarded by existing laws, by the general character of the institutions which authorise animal experimentation and by the general character of the individuals engaged therein,

"*Therefore be it resolved* that this Association agrees fully with the fundamental aim of those whose efforts are devoted to the safeguarding of the rights of animals, but deprecates unwise attempts to limit or prevent the conduct of animal experimentation such as have recently been defeated in California and Oregon, for the reason that such efforts retard advance in methods of prevention, control, and treatment of disease and injury of both man and animals, and threaten serious economic loss; and be it further

"*Resolved* that a copy of these resolutions be included in the official records of this Association, and that copies be sent to the National Congress, to the

Legislatures of each State in the Union, and to each member of the Association."

"Whereas the clean culture of roadsides and the drainage of marshes in the United States is imperilling the existence of the wild life of our country not now included in special preserves; and whereas the preservation of this wild life not in preserves is felt to be of great national importance, not only to students and lovers of Nature, but to human welfare in general, therefore

"*Be it resolved* by the council of the American Association for the Advancement of Science that it appreciates the importance of preserving this wild life not in preserves, and that it lends its moral support to the effort to combine all interested organisations in a co-operative investigations and conservation programme for the preservation of our unprotected wild life."

"Whereas, in recognition of the unique character and value of our national parks and monuments to present and future generations, twenty-four successive Congresses have wisely resisted attempts to commercialise them and have preserved them inviolate for nearly half a century; and whereas certain private interests are now seeking to secure special privileges in these areas, which if granted will seriously interfere with their true purpose and undoubtedly result in the entire commercialisation of these unique national museums,

"*Therefore be it resolved* that the American Association for the Advancement of Science requests members of Congress, first, to amend the Water Power Act so that it shall not apply to national parks and monuments, and that their full control be restored to Congress; and, secondly, to reject all present and future measures which propose to surrender any part of these national parks and monuments to private control or to divert them in any way from their original and exclusive purpose, the preservation for all future generations of unique representations of natural conditions such as exist in no other part of the world."

Indian Agriculture.

AGRICULTURE in India is of special importance in that it is the chief industry of that great country, in comparison with which all others are relatively unimportant. Of its two chief aspects crop production is more to the front than animal husbandry; and, now that the world-shortage of food is so acute, more and more attention is being directed to the improvement of the crops in both quality and quantity. The present position of affairs is concisely summed up by Mr. A. Howard (Journ. Roy. Soc. Arts, vol. lxviii., July, 1920).

India is essentially a land of small cultivators, intensely conservative, usually poor, and unable to afford to take risks in the adoption of new methods. Progress is consequently very slow, and is chiefly being made by the improvement of varieties and by gradual changes in methods of cultivation. Since 1905 better varieties of wheat, rice, jute, tobacco, and cotton have been introduced, adding in many cases nearly 1*l.* per acre to the profits of the cultivators. Little attention was formerly paid to the seed sown, and the resulting product was very mixed and lacked uniformity. By gradual selection of the better types from the original mixtures and by organisation of the seed distribution the value of the crops has gradually been much increased. Though high yield is of the greatest importance, many of the best yielding varieties are slow in maturing, rendering them unsafe to use on account of the short growing season. The best results are obtained with adaptable varieties, which do well over a wide range of conditions, and combine fair yield and quality with rapid growth and early maturity. The distribution of the improved seed supply presented many difficulties, but these have been overcome by enlisting the help of every kind of local agency and systematically replacing the old mixed varieties in village after village.

Crop yield in India is often depressed by the deficiency in soil aeration brought about by injudicious irrigation by flooding. When the land is constantly flooded it becomes temporarily waterlogged, and the oxygen content is so much lowered that plants cannot grow satisfactorily. Experiments indicate that a less number of floodings would give better results. Tests made at Coimbatore (R. C. Wood and K. R. Acharya, "Year Book," Madras Agricultural Department, 1919) show that in many cases a more economical and beneficial use of the available water can be made by means of a system of furrow irrigation, though flooding is apparently more necessary for such crops as wheat, which need heavier watering. In this connection adequate drainage is of great importance, as during the rains surface-waterlogging is very common, resulting not only in deficient aeration, but also in a lowering of the fertility of the soil by denitrification. A month's waterlogging may reduce the yield of wheat by as much as sixteen bushels to the acre. Surface drainage by means of trenches about 2 ft. deep has proved effective, and the water so collected may be utilised by running it on to low-lying rice-fields. With improved drainage it is possible to grow the more deeply rooted crops which fail owing to the rotting of their roots when water is held up in the soil.

The temperature of the soil is another factor bearing a close relation to the crop. If the soil is too warm at the usual time for sowing wheat the seedlings do not thrive, and are liable to attack by white ants; the damage has been proved to be due to the partial destruction of the root-system of the seedlings by the high soil temperature. Suggested remedies are the postponement of sowing for a week and the opening of furrows to cool the soil by evaporation.

The advances outlined above are now being followed up by the gradual introduction of modern methods of manuring, and experiments with artificial fertilisers suggest possibilities for the future. W. A. Davis (Indigo Publication No. 6, Pusa) has obtained remarkable results by the use of superphosphate on cereal crops, emphasising the fact that if the soil is poor in organic matter this deficiency must be made good before the superphosphate can act efficiently. Green manuring with sannai (*Crotalaria juncea*) often meets this difficulty satisfactorily. Similar increases have been obtained with indigo crops, and the response to manurial treatment is considered to make the future position of natural indigo very hopeful, the one essential being that cheap supplies of phosphatic manures shall be available to planters in the near future.

In Mysore the millet "ragi" (*Eleusine coracana*) is of pre-eminent importance, as it covers one-third of the total cultivated area, and is the staple food of four-fifths of the people. L. C. Coleman (Dept. Agric. Mysore, Bull. 11) sets forth the results of much experimental work on the improvement of this crop as regards methods of cultivation, manuring, and seed selection, together with much useful information with regard to the habit of growth of the plant and the diseases to which it is liable. Although no tests seem to have been made, it is suggested that on the typical "ragi" soils basic slag and bonemeal would probably be more advantageous than superphosphate.

The most casual survey of the available literature shows clearly that the possibilities of agriculture in India are being recognised as never before. Indian soils have hitherto been starved, and much of the cultivated land has almost reached the maximum state of impoverishment (D. Clouston, *Agric. Journ. India*, vol. xv.), and, consequently, it is likely to respond well to manurial treatment. Fungal diseases and insect pests take heavy toll of the crops, and demand much investigation before they can be controlled. Nevertheless, the need for improvement is fully recognised, and steady but slow progress in this direction is being made by the patient and determined efforts of the many workers who have the interests of the country at heart, and the advance already made is of good augury for the future.

W. E. BRENCHLEY.

Precious Stones in 1919.

THE long and valuable series of annual reports on precious stones commenced by Dr. George F. Kunz, of New York, in 1883 in the publications of the United States Geological Survey, and continued by him since 1907 in the *Mineral Industry*, bears witness to his enthusiasm for a subject in which he is the leading authority. His latest report, for 1919, has just been issued as an advance chapter (30 pages) of vol. xxviii. of the *Mineral Industry*. From it the following points are extracted:

During the war period the demand for articles of luxury naturally fell, but now a marked reaction has set in, and sales in Paris and elsewhere already exceed those of the pre-war period. Not only are a greater number of articles sold, but they also command higher prices. This is especially the case in the United States, where the annual value of the imports of precious stones is now (105,000,000 dollars in 1919) more than double ever before. As with everything else, the war has had far-reaching effects on the trade in precious stones. Difficulties have arisen owing to the varying rates of monetary exchange, labour questions, and the shifting of the centres of industry. Efforts are being made to discover fresh sources of supply. As in previous times of great disturbance, speculators and refugees acted wisely who converted perishable goods and almost worthless paper-money into portable and durable jewels.

Diamond is by far the most important item. To the South African output, which is controlled by the London Diamond Syndicate, the new territory of South-West Africa contributes 21 per cent. The total production of the Union in 1919 of rather more than 2,500,000 carats (about half a ton) amounts to only half that for the year 1913, but the value (nearly 12,000,000*l*. sterling) is actually greater, so great has been the advance in price. The sales, however, somewhat exceeded the production for the year, the reserve stock having been drawn upon. "River stones," being of better quality, command higher prices; the average in 1919 was just above 13*l*. per carat, as against 4*l*. in 1915. These stones are now being collected from the bed of the Vaal River with the aid of diving-bell caissons and compressed air. A notable diamond is one of 1500 carats (=300 grams) found in the Premier Mine, near Pretoria, in 1919; it is, perhaps, a portion of the same large crystal as the famous "Cullinan" diamond found in 1905. New diamond fields are recorded in Kenya Colony, Gold Coast, Bechuanaland, Griqualand West, and Orange Free State. The Belgian Congo yielded in 1919 about a quarter of a million carats, whilst the returns from other countries (except a small quantity from British Guiana) are practically negligible.

As a diamond-cutting centre Amsterdam still takes the lead, but the industry is now being developed in England, particularly at Brighton for the employment of disabled soldiers. More cutting is also being done in America, as shown by the increased imports of uncut stones, and the establishment of cutting works in South Africa is under consideration. For these reasons the Dutch are considering the possibility of increasing the output from Borneo by systematic mining. The Arkansas diamond field is also to be explored more systematically. Besides its use as a gem, diamond has many important technical applications, but it is a significant fact that the American imports do not show an increase in this direction, the enormous increase noted above being accounted for by the imports of cut, but unset, gems.

Pearls form the next largest item in the American imports. Here again attempts are being made to increase the production of the pearl fisheries on the western coasts of Central America, whilst the freshwater pearls of the rivers of the United States are likely to be collected on a large scale.

Corundum gems show a steady, though comparatively small, output from Upper Burma (ruby and sapphire) and from Fergus County, in Montana (sapphire). Opal deposits are now being successfully developed in South Australia, and a new deposit of "black opal" has been discovered in New South Wales. Fine examples of "fire-opal" are mentioned from Western Australia. A fine mass of precious opal weighing 527 grams has been found in the new opal-mining district in Nevada. Mention is made of the beautiful, bright blue zircons which have recently appeared in the gem market, but no information is given as to their source. This has been variously suggested to be Ceylon, India, Siam, or Queensland; it is evidently kept a secret for trade purposes.

L. J. S.

Copper Deposits of Arizona.

A VERY complete and highly interesting monograph on the copper deposits of Ray and Miami, Arizona, by Mr. F. L. Ransome has just been issued by the United States Geological Survey as Professional Paper 115. These ore-bodies have rapidly attained first-class importance among the great copper producers of the United States. For a good many years, dating back to 1880, work had been carried on in this district, the small richer veins being worked and a fair amount of copper won, but these deposits were not of a permanent character. About 1905 the attention of mining men was directed to the low-grade disseminated ore of the region, and work on this commenced about 1911. Up to 1918 nearly 46,000,000 tons of this ore had been mined and 490,000 tons of copper produced. The reserves in one group of these mines, that of the Ray Consolidated Copper Co., were estimated in 1916 as more than 93,000,000 tons, averaging 2·03 per cent. of copper; those in the Miami mines at 50,000,000 tons, averaging 1·6 per cent.; and those in the Inspiration mine at 97,000,000 tons, carrying 1·63 per cent. The ore-bodies are large, irregular, flat-lying masses, and consist partly of Pinal schist and partly of granite and monzonite porphyry, carrying disseminated copper ore, some being more or less uniformly distributed through the rock and some concentrated in threads or veinlets. The copper occurs principally as chalcocite, though chalcopyrite is also met with. The ore-deposits have apparently been formed by a process of secondary enrichment upon rock that contained relatively little copper. The latter is termed by the author "protore," and apparently contained from 0·4 to 0·8 per cent. of copper. This "protore" appears to have been formed by the action of thermal alkaline sulphide waters carrying copper in solution, and there is considerable evidence that the presence of great bodies of monzonite porphyry lying far deeper than the present ore-bodies were in some way connected with the presence of these hypogene solutions.

University and Educational Intelligence.

CAMBRIDGE.—H.R.H. the Prince of Wales will visit the University to receive an honorary degree on May 31 next.

Mr. A. D. Browne has been elected to a fellowship at Queens' College. Mr. W. M. Smart, Trinity College, chief assistant at the observatory, has been appointed to the John Couch Adams astronomership, recently founded under a bequest by the late Mrs. Adams.

Smith's prizes have been awarded to L. A. Pars, Jesus College, for an essay on "The General Theory of Relativity," and to W. M. H. Greaves, St. John's College, for an essay on "Periodic Orbits in the Problem of Three Bodies."

A course of thirty lectures on applied entomology is to begin in the Easter term and Long Vacation by Mr. F. Balfour Browne for those students who wish to complete their training for such work in the tropics or in this country.

DR. WALTER E. COLLINGE, of St. Andrews University, has been appointed keeper of the York Museum.

THE annual gathering of the South-Western Polytechnic Institute, Chelsea, will be held to-morrow, March 11. The chair will be taken at 8.15 p.m. by Mr. C. H. St. J. Hornby (chairman of the governing body), and a lecture will be given by Prof. A. Harden on "Vitamins—Essential Constituents of Food."

THE National Union of Scientific Workers announces a public meeting to be held on Tuesday, March 15, at 6 p.m., in the Geology Theatre, Royal School of Mines, South Kensington, when Mr. W. Brierley will speak on "Personal Impressions of American Biological Research." The chair will be taken by Sir A. D. Hall.

IN view of the large demand for tickets for the lecture on "Himalayan Exploration, with Special Reference to Mount Everest," recently delivered by Profs. J. N. Collie and E. J. Garwood at University College, London, the lecture will be repeated on Monday, March 21, at 5.15 p.m., at the college. The proceeds of the lecture will be devoted to the College Athletic Ground Fund, for which a sum of 6000*l.* is needed.

AT a recent meeting of the Bristol University Colston Society Committee it was decided to alter the title of the society to Colston University Research Society. Originally founded as the University College Colston Society in 1899, its funds were applied in the first instance to the General Sustentation Fund of the college, and afterwards to a considerable extent to propaganda work in connection with the proposed Bristol University. On the establishment of the University the society automatically became the University Colston Society. At the same time the decision was made to apply the funds of the society henceforth to the support of research work within the University. The new name, Colston University Research Society, emphasises the fact that the society exists to support research work within the University, and should make it clear that the funds are devoted entirely to facilitate and extend this work, the value of which to the industrial and commercial world and to the community at large cannot be over-estimated. The annual dinner of the society is fixed for May 23, being the day preceding Founder's Day, and this day has been adopted now as a permanent date. The president is Alderman F. Sheppard, and Sir William Bragg, Quain professor of physics in the University of London, has accepted the invitation to be present as the guest of the society. The president-elect is Mr. E. Walls.

A VERY interesting and comprehensive course of six lectures on Italian engineering is now being given under the auspices of the University of London by Prof. Luiggi, of the University of Rome, at the Institution of Civil Engineers. In his first lecture, presided over by the Italian Ambassador, Prof. Luiggi outlined the subjects he proposed to consider, and pointed out that an impelling motive of nearly all modern engineering work in Italy was the necessity of increasing the food production of the country by irrigation and by the reclamation of marshy lands in order to provide for a present population of about 40,000,000, which is increasing at the rate of 500,000 a year. Another vital problem is to develop their great water-power resources owing to the scarcity of fuels and the impossibility of paying for imported coal and other fuels at present-day prices. In southern Italy, where water is scanty, it has been necessary to construct the Apulian aqueduct, nearly 1000 miles long, and by far the largest work of its kind in the world. In his second lecture some important irrigation canals will be described and the various schemes of reclaiming marshy land by drainage canals, by silting up with muddy flood-water, and by pumping. The main topic of the third lecture will be the great hydro-electric installations, some of which have units of 20,000 h.p. working under exceptionally high heads, as in the "Adamello," where an available fall of 3000 ft. has been successfully utilised for several years, although this working head will be surpassed in other plants now under construction. Applications of electrical power to railways will also be described, as will an extremely interesting power station at Larderello in Central Tuscany, in which steam for three turbines, each of 4000 h.p., is derived from volcanic heat tapped by pipes driven to depths of from 500 ft. to 600 ft. The University of London is particularly fortunate in having so distinguished an authority and so able a lecturer as the president of the Institution of Civil Engineers in Rome to give this course of lectures to its students and the engineering world.

Calendar of Scientific Pioneers.

March 10, 1810. Henry Cavendish died.—Of noble birth and a natural philosopher in the widest sense of the term, Cavendish spent practically all his life in the pursuit of science, carrying out most of his work in his secluded home at Clapham. His experiments on air led to the discovery of the constant quantitative composition of the atmosphere, of the composition of water, and of nitric acid, and paved the way to the discovery of argon. He measured the density of the earth, and left a mass of valuable material relating to electricity which was published by Maxwell. Biot referred to him as "le plus riche de tous les savants, et probablement aussi le plus savant de tous les riches." He is buried in All Saints' Church, Derby.

March 10, 1882. Sir Charles Wyville Thomson died.—Especially remembered as a student of the biological conditions of the depths of the sea, Thomson took part in the dredging expeditions in the *Lightning* and *Porcupine* (1868–69), and was scientific head of the *Challenger* Expedition. From 1870 until his death he was professor of natural history in Edinburgh University.

March 10, 1900. George James Symons died.—An indefatigable worker in meteorology, Symons published thirty-nine annual volumes of statistics of British rainfall observations, and was the founder of *Symons's Meteorological Magazine.*

March 13, 1845. John Frederic Daniell died.—Professor of chemistry at King's College, London, Daniell was the inventor of a hygrometer, a pyrometer, and the electric cell which bears his name. He wrote valuable works on meteorology and chemical philosophy.

March 14, 1874. Johann Heinrich Mädler died.—For many years director of the Dorpat Observatory, Mädler with Beer constructed a fine map of the moon. He wrote a history of astronomy, and in 1841 pointed out the probability of the existence of a planet exterior to Uranus.

March 15, 1897. James Joseph Sylvester died.—Holding chairs successively at University College, London, Virginia, Woolwich, Johns Hopkins University, and Oxford, Sylvester exerted a powerful influence on the study of mathematics both in England and in America. It has been said that in brilliancy of conception, in acuteness of penetration, and in fluency and richness of expression he has had few equals among mathematicians.

March 15, 1910. Hans Heinrich Landolt died.—The friend and contemporary of Lothar Meyer, Beilstein, and Kekulé, Landolt held professorships at Bonn, Aachen, and Berlin, and in 1891 succeeded Rammelsburg as director of the Berlin Chemical Institute. He carried out many investigations in physical chemistry dealing mainly with the chemical composition of substances and their optical properties.

March 16, 1838. Nathaniel Bowditch died.—At first assistant to a ship-chandler, Bowditch became a supercargo, then a captain, and later actuary to an important American insurance company. Known as a mathematician, he spent nearly twenty years in translating and annotating the "Mécanique Céleste" of Laplace. For several years he was president of the American Academy of Arts and Sciences.

March 16, 1841. Félix Savart died.—Trained as a doctor, Savart made investigations in molecular physics, and was chosen successor to Ampère in the chair of experimental physics in the Collège de France.

E. C. S.

Societies and Academies.

LONDON.

Royal Society, February 24.—Prof. C. S. Sherrington, president, in the chair.—Sir E. Ray **Lankester**: A remarkable flint implement from Selsey Bill. The implement, together with two hammer-stones, was found resting with other large broken flints on a bed of clay underlying "the Coombe rock gravel," and exposed by tidal action on the shore of Selsey Bill, by E. Heron-Allen in 1911. It is of large size, of rostrate form, with a convex dorsal and flat ventral surface, and has been shaped by powerful blows, resulting in coarse flaking of undoubted human workmanship. It belongs to a very early Palæolithic horizon, probably pre-Chellean. The only flint implements of similar weight and size known are two also of very early (viz. Upper Pliocene) age. It is suggested that the race of men who made and used such an implement had larger hands and more powerful limbs than the more modern races.—Dr. E. J. **Allen**: Regeneration and reproduction of the Syllid Procerastea. *Procerastea halleziana* was found living in membranous tubes on the stems of the hydroid Syncoryne. The worm was observed to feed by piercing the body-wall of the hydranths with its extruded pharynx and pumping out the contents of the gastral cavity of the hydroid. Sexual reproduction occurs, each individual forming a single large stolon which is set free as a male Polybostrichus or a female Sacconereis. Procerastea were also found undergoing rapid multiplication by a process of fragmentation, followed by the regeneration of anterior and posterior ends. Fragmentation can be induced by artificial means, and takes place in a definite way. The rate of regeneration of the different sections varied according to the region of the body from which they came, being most rapid in those from the middle region. Regeneration of anterior segments appears to continue until the original segments come to occupy exactly the same position in the regenerated worm as they had occupied in the parent.—E. C. **Grey** and E. G. **Young**: The enzymes of *B. coli communis*. Part ii.: (*a*) Anaerobic growth followed by anaerobic and aerobic fermentation. (*b*) The effects of aeration during the fermentation. (*a*) Anaerobic fermentation of glucose by an emulsion of *B. coli communis* proceeds differently according as the organisms have been grown previously with or without oxygen. When the immediate past history has been anaerobic, the fermentation under anaerobic conditions yields acetic acid in large proportion. Admission of oxygen during the fermentation leads to lactic acid production. (*b*) The effect of introducing oxygen in the fermentation of glucose by *B. coli communis* is to increase the lactic, acetic, and succinic acids, and to diminish the hydrogen, carbon dioxide, and formic acid, but to leave the alcohol unchanged. Under anaerobic conditions greater variations occur in the proportion of alcohol to acetic acid than under aerobic conditions. One effect of the introduction of oxygen during fermentation is to inhibit the mechanism of auto-reduction, which is responsible for the variations in alcohol when such occur. The products of aerobic fermentation contain less oxygen than the corresponding products of anaerobic fermentation of glucose; but there is a gain of oxygen in both cases upon the original glucose. If this extra oxygen comes from the water, one effect of the introduction of oxygen is to diminish the part played by water in the reactions.—Dr. A. E. **Everest** and A. J. **Hall**: Anthocyanins and anthocyanidins, part iv. The paper deals with the constitution of the blue anthocyan pigments in flowers and with the manner in which anthocyan pigments are formed in Nature. The conclusions of Shibata and of Shibata and Kasiwagi concerning the constitution of the blue anthocyan pigments in flowers are compared with those of Willstätter and Everest. Important differences exist between the complex salts formed by the anthocyan pigments with the salts of such metals as iron and the blue pigments present in flowers. The blue plant pigments investigated are probably comparable to the alkali phenolates of the flavonols. In plant synthesis the flavonols are probably first formed, and from them the anthocyans.

Zoological Society, February 22.—Sir S. F. Harmer, vice-president, in the chair.—A. **Mallock**: Colour-production in relation to the coloured feathers of birds.—E. D. **Jones**: Descriptions of new moths from South-East Brazil.—Dr. J. **Stephenson**: The morphology, classification, and zoogeography of the Indian Oligochæta.—Dr. R. **Broom**: The structure of the reptilian tarsus.

EDINBURGH.

Royal Society, February 7.—Prof. F. O. Bower, president, in the chair.—T. B. **Franklin**: The relation of the soil colloids to the conductivity of the soil. Soil conductivity can be measured qualitatively by the value R_4/R_0, where R_4 and R_0 are the temperature ranges at the 4-in. depth and at the surface. The effects of weather changes—rain, snow, frost, surface mulch, evaporation, water content, and period —on R_4/R_0 have been discussed in a previous paper, and if these changes are all eliminated a constant value for the ratio should be obtained in any soil. Experiments with sand and clay loam showed that this constant value was obtained in sand, but not in clay loam; in the latter soil it varies with changes of the mean soil temperature. Thus when all other weather changes had been eliminated, but the mean soil temperature varied between 10° C. and 22° C., R_4/R_0 for sand lay between 0·50 and 0·52, while for clay loam it lay between 0·37 and 0·45. Moreover, ignited clay loam behaved exactly like sand, showing that the cause of the variation was destroyed by ignition; it is suggested that the colloidal clay is the cause of this temperature coefficient of conductivity in clay soil.—J. M. **Wordie**: (1) The Shackleton Antarctic Expedition of 1914–17: Bathymetrical observations in the Weddell Sea. (2) The natural history of pack-ice as observed in the Weddell Sea, 1914 to April, 1916. The oceanographical results of the Shackleton Antarctic Expedition of 1914–17 are given. The pack-ice was studied from the time that it formed and imprisoned the *Endurance* in January, 1915, until it finally melted in April, 1916, 900 miles farther north. Prominence is given to the fact that the pack is continually in motion, to the pressure phenomena which are the result, and to the changes, particularly as regards salinity, which take place as the floes become older. The movement of the ice was governed by the wind, which drove the pack westwards round the Antarctic continent and outwards to lower latitudes. Between the Arctic and the Antarctic pack-ice there was apparently no difference except that of age; Antarctic floes were seldom more than two years old, but otherwise they resembled the ice of the polar basin, and even the so-called "palæocrystic ice." The various types of ice and pressure and the present-day terminology were illustrated by numerous photographs. The long series of soundings made in the Weddell Sea supplement those made by Dr. Bruce in the *Scotia*. A new and unexpected feature was the discovery in the south-west of a shallow area with depths about 200 fathoms over a distance of nearly 300 miles. The abnormal depth of the continental shelf at this place and elsewhere in the Antarctic was regarded as the result of earth-movement. The soundings and drift of the ice practically settled the vexed question of Morrell's Land, the existence of which is now considered highly improbable. A description is given of the deep-sea deposits of the Weddell Sea; .. form the only data for deducing the geological structure of the ice-covered Coats Land.

PARIS.

Academy of Sciences, February 14.—M. Georges Lemoine in the chair.—H. **Le Chatelier**: Saline double decompositions and their graphical representation. A description of a method of plotting a system of a pair of salts, taken in molecular proportions, and the pair resulting from their mutual decomposition in a square. The system

$$NaNO_3 + NH_4Cl = NH_4NO_3 + NaCl$$

is given as an illustration, the recent data of M. Rengade being used.—L. **Lecornu**: The varied movement of fluids.—M. Louis Joubin was elected a member of the section of anatomy and zoology in succession to the late M. Yves Delage.—G. **Giraud**: Automorph functions.—T. **Varopoulos**: Some points in the theory of numbers.—A. **Egnell**: The determination of congruences of right lines the mean plane of which is given.—H. **Villat**: The cyclic movements of a fluid limited by a wall and containing a solid.—P. **Ravigneaux**: Graphical method for the study of epicyclic trains.—B. **Gambier**: Articulate systems, deformable or transformable.—E. **Œhmichen**: A series of flights with a free helicopter carried out on January 15, 28, and 29, 1921. About one-fifth of the total dead-weight was carried by a small hydrogen balloon, and the apparatus was lifted from 0·5 to 3 metres from the ground and maintained in equilibrium. Landing was easy.—C. **Frémont**: The fragility of some welded steel joints. As ordinarily carried out, electrically welded steel is weaker at the join than in the body of the metal, and this is due to the inclusion of oxide. If sufficient pressure is applied during welding to squeeze out some molten metal this source of weakness is removed, but there is still a weak blue zone some distance away from the weld.—J. **Guillaume**: Observations of the sun made at the Lyons Observatory during the fourth quarter of 1920. Observations were possible on sixty-five days during the quarter, and the results are grouped in three tables, showing the number of spots, their distribution in latitude, and the distribution of the faculæ in latitude.—MM. P. **Bernard** and **Barbe**: An apparatus for lighting and extinguishing public gas-lamps. A description of an apparatus controlled by a slow increase of pressure (about 3 in. of water) from the gasworks. The cycle of three operations, lighting, extinguishing, and resetting, is worked by three slow-pressure waves.—MM. P. **Jolibois**, R. **Bossuet**, and **Chevry**: Fractional precipitation.—R. **Audubert**: The mechanism of the energy exchanges in evaporation. Evaporation is a discontinuous phenomenon. The elementary quantum has a value near $10 \times 10^{-16}\ T_0$ ergs; it represents the work required to evaporate a molecule, and can be expressed as a variation of the superficial energy.—M. **Barlot**: The displacement of metals in saline solutions. An experimental study of the replacement of one metal by another in their homogeneous layers. Four examples of the effects produced are illustrated.—C. **Matignon**: Reactions producing magnesium.—Mlle. Jeanne **Lévy**: Some retropinacolic transpositions. A discussion of the causes of the transposition represented by

$$CR_3.CH(OH).R' \longrightarrow CR_2{=}CRR'.$$

—Mlle. A. **Roux** and J. **Martinet**: The catalytic *rôle* of mercury in the sulphonation of anthraquinone.—MM. M. **Tiffeneau** and **Orékhoff**: The pinacolic nature of some transpositions in the phenyldimethylglycol series.—L. **Gaucher** and G. **Rollin**: A new calcium salt.—D. **Florentin** and H. **Vandenberghe**: A criticism of the methods of estimating small quantities of carbon monoxide in air- and flue-gases. A comparison of the iodine pentoxide and blood methods, the latter being preferred.—A. **Romieux**: The evolution of terrestrial dynamism.—E. **Le Danois**: Fishing maps. An account of maps prepared for the Office scientifique des pêches.—A. **Paillot**: The mechanism of humoral immunity in insects.—F. **Pickard** and T. **Pagliano**: The biology of *Haltica ampelophaga*.—L. **Besson**: The influence of temperature on the number of deaths through infantile diarrhœa in Paris.

Books Received.

Germination in its Electrical Aspect: A Consecutive Account of the Electro-Physiological Processes Concerned in Evolution. By A. E. Baines. Pp. xxi+185. (London: G. Routledge and Sons, Ltd.; New York: E. P. Dutton and Co.) 12*s*. 6*d*. net.

The Physiology of Protein Metabolism. By Prof. E. P. Cathcart. (Monographs on Biochemistry.) New edition. Pp. viii+176. (London: Longmans, Green and Co.) 12*s*. 6*d*. net.

Six Papers by Lord Lister. With a short Biography and Explanatory Notes by Sir Rickman J. Godlee. (Medical Classics Series.) Pp. vii+184+iv plates. (London: J. Bale, Sons and Danielsson, Ltd.) 10*s*. net.

The Practical Electrician's Pocket Book for 1921. Edited by H. T. Crewe. Pp. lxxii+522. (London: S. Rentell and Co., Ltd.) 3*s*. net.

Le Mouvement Biologique en Europe. By Georges Bohn. Pp. 144. (Paris: A. Colin.) 4 francs.

Annals of the South African Museum. Vol. xviii., part 1. Pp. 180+2 plates. (Cape Town; London: Adlard and Son and West Newman, Ltd.) 20*s*.

Morphologie und Biologie der Strahlenpilze (Actinomyceten). By Prof. R. Lieske. Pp. ix+292+4 Tafel. (Leipzig: Gebrüder Borntraeger.) 108 marks.

Chemistry. By G. H. J. Adlam. (Science for All Series.) Pp. x+238. (London: J. Murray.) 3*s*. 6*d*. net.

Notes on a Cellar-Book. By G. Saintsbury. New edition. Pp. xxxi+228. (London: Macmillan and Co., Ltd.) 7*s*. 6*d*. net.

Wireless Telegraphy: With Special Reference to the Quenched-Spark System. By B. Leggett. (The D.-U. Technical Series.) Pp. xv+485. (London: Chapman and Hall, Ltd.) 30*s*. net.

The Principles of Politics: An Introduction to the Study of the Evolution of Political Ideas. By Prof. A. R. Lord. Pp. 308. (Oxford: Clarendon Press.) 8*s*. 6*d*. net.

An Elementary Text-Book of Zoology for Indian Students. By Prof. B. L. Bhatia. Adapted from "An Elementary Course of Practical Zoology," by Prof. T. J. Parker and Prof. W. N. Parker. Pp. xii+721. (London: Macmillan and Co., Ltd.) 21*s*. net.

Report of the Proceedings of the Third Entomological Meeting held at Pusa on the 3rd to 15th February, 1919. Edited by T. Bainbridge Fletcher. Vol. i. Pp. xii+417+69 plates. Vol. ii. Pp. vi+418–835+70–129 plates. Vol. iii. Pp. vi+836–1137+130–182 plates. (Calcutta: Government Printing Office.) 17.8 rupees for 3 vols.

Pre-Kensington History of the Royal College of Science and the University Problem. An Address delivered before the Old Students' Association of the Royal College of Science, London, September, 1920, by Prof. H. E. Armstrong. Pp. 23. (London: Lamley and Co.) 2*s*. 6*d*.

The Lands of Silence: A History of Arctic and Antarctic Exploration. By Sir Clements R. Markham. Pp. xii+539. (Cambridge: At the University Press.) 45*s*. net.

Kincardineshire. By the late G. H. Kinnear. Pp. xi+122. (Cambridge: At the University Press.) 4*s*. 6*d*. net.

The Mechanical Production of Cold. By Sir J. A. Ewing. Second edition. Pp. x+204. (Cambridge: At the University Press.) 25*s*. net.

The Resources of the Sea. By Dr. W. C. McIntosh. Second edition. Pp. xvi+352. (Cambridge: At the University Press.) 35*s*. net.

Diary of Societies.

THURSDAY, MARCH 10.

INSTITUTE OF METALS (Annual General Meeting) (at Institution of Mechanical Engineers), at 10.30.—H. Moore, S. Beckinsale, and Clarice E. Mallinson: The Season Cracking of Brass and Other Copper Alloys.—Dr. J. L. Haughton: The Constitution of the Alloys of Copper with Tin, Parts III. and IV.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Dr. G. C. Simpson: The Meteorology of the Antarctic.

ROYAL SOCIETY, at 4.30.—Sir Joseph Larmor: Electro-crystalline Properties as Conditioned by Atomic Lattices.—Lord Rayleigh: The Colour of the Light from the Night Sky.—Prof. A. S. Eddington: A Generalisation of Weyl's Theory of the Electromagnetic and Gravitational Fields.—Prof. T. R. Merton: Spectrophotometry in the Visible and Ultra-violet Spectrum.—Prof. W. A. Bone: Researches upon Brown Coals and Lignites.—Prof. H. N. Russell: A Superior Limit to the Age of the Earth's Crust.—H. Ohshima: Reversal of Asymmetry in the Plutei of *Echinus miliaris*. With a Note by Prof. E. W. MacBride.

LONDON MATHEMATICAL SOCIETY (at Royal Astronomical Society), at 5.—J. Brill: Note on the Electrodynamic Equations.—T. W. Chaundy: A Method for the Solution of Certain Linear Partial Differential Equations.—C. W. Gilham: An Extension of Two Theorems on Jacobians.—G. H. Hardy and J. E. Littlewood: (1) The Approximate Functional Equation in the Theory of Riemann's Zeta-function. (2) Summation of a Certain Multiple Series.—S. Pollard: A New Condition for Cauchy's Theorem.—E. G. C. Poole: Certain Classes of Matthieu Functions.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. A. Whitfield: Some Points in the Etiology of Skin Diseases (Lumleian Lectures).

ROYAL SOCIETY OF MEDICINE (Balneology and Climatology Section), at 5.30.—Discussion: The Place of Baths and Health Resorts in Gynæcology.

INSTITUTION OF ELECTRICAL ENGINEERS (at Institution of Civil Engineers), at 6.—Prof. E. Wilson: Feebly Magnetic Materials: Practical Applications.

OPTICAL SOCIETY (at Imperial College of Science), at 7.30.—Prof. H. F. Newall: The Story of a New Star (Lecture).—T. F. Connolly: Note on a Handy Form of Measuring Microscope.

ROYAL SOCIETY OF MEDICINE (Neurology and Ophthalmology Sections, Joint Meeting), at 8.—Dr. G. Holmes, L. Paton, and Others: Ocular Palsies.

SOCIETY OF ANTIQUARIES, at 8.30.

FRIDAY, MARCH 11.

ASSOCIATION OF ECONOMIC BIOLOGISTS (in Botanical Lecture Theatre, the Imperial College of Science), at 2.30.—Exhibits and Short Communications.—Dr. J. Davidson: The Cells of Plant Tissues in Relation to Cell-sap as the Food of Aphids.—E. R. Speyer: Ceylon Scolytid Beetles: their Bionomics and Relation to Ambrosia Fungi and Problems of Plant Physiology.

ROYAL ASTRONOMICAL SOCIETY, at 5.—W. H. Wright: Occurrence of Enhanced Lines of Nitrogen in Spectra of Novæ. Second Note.—W. J. Luyten: Visual and Photographic Light-curve of V18=RZ Cephei.—Adml. Sir A. M. Field: The Solar Eclipse Expedition, 1922.—A. S. Williams: A New Variable Star in Perseus.—J. Halm: The Relations between the Masses, Mean Densities, and Luminosities of the Stars.—J. Halm: The Relation between the Velocities of the Stars and their Masses.—Rev. H. E. Macklin: The Clusters h and χ Persei.—Rev. J. Rowland: Note on the Magnitude Curves in Mr. Macklin's Paper.—R. T. Cullen: Note on the Travelling Wire Micrometer of the Greenwich Transit-circle.

PHYSICAL SOCIETY OF LONDON (at Imperial College of Science), at 5.—Prof. A. A. Michelson: Some Recent Applications of Interference Methods (Sixth Guthrie Lecture).

ROYAL SOCIETY OF MEDICINE (Clinical Section), at 5.30.

INSTITUTION OF ELECTRICAL ENGINEERS (Students' Meeting) (at King's College), at 6.30.—J. A. Broughall: Some Recent Developments in Converting Machinery for Small Substations.

ROYAL SOCIETY OF MEDICINE (Neurology and Ophthalmology Sections, Joint Meeting), at 8.30.—Dr. G. Holmes, L. Paton, and Others: Ocular Palsies.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Dr. J. Freeman: Medical Idiosyncrasies.

SATURDAY, MARCH 12.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir Ernest Rutherford: Electricity and Matter.

PHYSIOLOGICAL SOCIETY (at Institute of Physiology, University College), at 4.

MONDAY, MARCH 14.

BIOCHEMICAL SOCIETY (Annual General Meeting) (at Lister Institute).

ROYAL GEOGRAPHICAL SOCIETY (at Lowther Lodge), at 5.—Col. Sir Charles Close, G. T. McCaw, and A. R. Hinks: Notes on New Map Projections.

ROYAL SOCIETY OF MEDICINE (War Section), at 5.30.—Col. H. E. R. James: The Best Form of Instruction for Medical Students to Fit Them to take Their Part in Case of National Emergency.

ROYAL SOCIETY OF MEDICINE, at 5.30.—Sir John McFadyean and Others: Discussion: The Eradication of Tuberculosis in Men and Animals.

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting) (at Chartered Institute of Patent Agents), at 7.—R. L. Morrison and Others: Discussion on Rectifiers.

INSTITUTE OF MECHANICAL ENGINEERS (Graduates' Meeting), at 7.—A. J. Watson: Commercial Motor-Vehicles.

SURVEYORS' INSTITUTION (Junior Meeting), at 7.—J. G. Elsworthy: Conversion of Buildings to Meet Modern Requirements.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.—H. P. Adams: Cottage Hospitals.

ROYAL SOCIETY OF ARTS, at 8.—Major G. W. C. Kaye: X-rays and their Industrial Applications.

MEDICAL SOCIETY OF LONDON (at 11 Chandos Street, W.1), at 8.30.—Sir Henry Gauvain and Others: Non-operative Treatment of Surgical Tuberculosis.

TUESDAY, MARCH 15.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. A. Keith: Darwin's Theory of Man's Origin, in the Light of Present-Day Evidence.

ROYAL SOCIETY OF MEDICINE (Therapeutics and Pharmacology Section), at 4.30.—P. B. Roth: The Uses of Heliotherapy.

ROYAL SOCIETY OF MEDICINE (General Meeting), at 5.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. A. Whitfield: Some Points in the Etiology of Skin Diseases (Lumleian Lectures).

ROYAL STATISTICAL SOCIETY (at Surveyors' Institution), at 5.15.—Sir James Wilson: The World's Wheat.

INSTITUTION OF PETROLEUM TECHNOLOGISTS (at Royal Society of Arts), at 5.30.—J. Kewley: The Crude Oils of Borneo.

NATIONAL UNION OF SCIENTIFIC WORKERS (in the Geology Theatre, Royal School of Mines), at 6.—W. Brierley: Personal Impressions of American Biological Research.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—A. S. Newman: The Design and Construction of the Reflex Camera.—Major A. Abrahams: The Use of the Reflex Camera.

ROYAL ANTHROPOLOGICAL INSTITUTE (Special Meeting), at 8.15.—E. Torday: Culture and Environment: Cultural Differences among the Various Branches of the Batetela.

WEDNESDAY, MARCH 16.

INSTITUTION OF NAVAL ARCHITECTS (at Royal United Service Institution), at 11.—Duke of Northumberland: Presidential Address.—Sir Eustace D'Eyncourt: Some Features of German Warship Construction.—S. V. Goodall: Ex-German Battleship *Baden*.—W. R. G. Whiting: The Strength of Submarine Vessels.

ROYAL METEOROLOGICAL SOCIETY (at Royal Astronomical Society), at 5.—Dr. G. C. Simpson: The South-West Monsoon (Lecture).

INSTITUTION OF ELECTRICAL ENGINEERS (Wireless Section) (at Institution of Mechanical Engineers), at 6.—G. Stead: The Effect of Electron Emission on the Temperature of the Filament and Anode of a Thermionic Valve.—Miss W. A. Leyshon and Prof. W. H. Eccles: Some Thermionic Tube Circuits for Relaying and Measuring.

ROYAL SOCIETY OF ARTS, at 8.—C. A. Mitchell: Science and the Investigation of Crime.

ROYAL MICROSCOPICAL SOCIETY, at 8.

THURSDAY, MARCH 17.

INSTITUTION OF NAVAL ARCHITECTS (at Royal United Service Institution), at 11.—R. J. Walker and S. S. Cook: Mechanical Gears of Double Reduction for Merchant Ships.—E. W. Blocksidge: Lifesaving Appliances on Cargo and Passenger Vessels.—M. E. Denny: The Design of Balanced Rudders of the Spade Type.

INSTITUTION OF NAVAL ARCHITECTS (at Royal United Service Institution), at 3.—H. B. W. Evans: Standardisation of Data for Airship Calculations.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Dr. G. C. Simpson: The Meteorology of the Antarctic.

CHEMICAL SOCIETY (Annual General Meeting), at 4.

ROYAL SOCIETY, at 4.30.—*Probable Papers*.—Lord Rayleigh: The Colour of the Light from the Night Sky.—R. O. Street: The Dissipation of Energy in Permanent Ocean Currents, with Some Relations between Salinities, Temperatures, and Currents.—S. Datta: The Vacuum Arc Spectra of Sodium and Potassium.—W. E. Garner and C. L. Abernethy: Heats of Combustion and Formation of Nitro-compounds. Part I. Benzene, Toluene, Phenol, and Methylaniline Series.—E. K. Rideal: The Catalytic Dehydrogenation of Alcohols.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. A. Whitfield: Some Points in the Etiology of Skin Diseases (Lumleian Lectures).

LINNEAN SOCIETY, at 5.—W. B. Alexander: The Vertebrate Fauna of Houtman's Abrolhos Islands, West Australia.—Prof. P. Fauvel: Annélides Polychètes de l'Archipel Houtman Abrolhos.—F. Chapman: Sherbornina: A New Genus of Foraminifera from Table Cape, Tasmania.

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 5.30.—Capt. D. Nicolson: Flying-Boat Construction.

INSTITUTION OF MINING AND METALLURGY (at Geological Society), at 5.30.—E. H. Clifford: Scheme for Working the City Deep Mine at a Depth of 7000 feet (adjourned discussion).—A. E. Pettit: Notes and Records of Mining Costs.

INSTITUTION OF ELECTRICAL ENGINEERS (at Institution of Civil Engineers), at 6.—Sir William Noble: The Long-distance Telephone System of the United Kingdom.

INSTITUTION OF AUTOMOBILE ENGINEERS (London Graduates' Meeting) (at 28 Victoria Street), at 7.30.—H. B. Benny and D. J. Macklin: Modern Tendencies in Automobile Engine Design.

ILLUMINATING ENGINEERING SOCIETY (at Royal Society of Arts), at 8.—Major A. Garrard and Others: Motor-Car Headlights: Ideal Requirements and Practical Solutions.

INSTITUTION OF NAVAL ARCHITECTS (at Royal United Service Institution), at 8.—Prof. T. B. Abell: A Study of the Framing of Ships.

RÖNTGEN SOCIETY (in Architecture Theatre, University College), at 8.15.—E. A. Owen and Phyllis K. Bowes: X-ray Dosage, with Special Reference to the Barium Platino-cyanide Pastille.

HARVEIAN SOCIETY (at Town Hall, Paddington Green), at 8.30.—Dr. L. Williams: The Thymus Gland in Everyday Life.

FRIDAY, MARCH 18.

INSTITUTION OF NAVAL ARCHITECTS (at Royal United Service Institution), at 11.—K. G. Finlay: The Spacing of Transverse Bulkheads.—A. M. Robb: Deflections of Bulkheads and of Ships.—J. J. King-Salter: Some Experiments on Tallows in their Use for the Launching of Ships.

MONTESSORI SOCIETY (at University College), at 5.45.—F. Watts: Common Sense about Intelligence Testing.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Prof. E. G. Coker, K. C. Chakko, and M. S. Ahmed: Contact Pressures and Stresses.

ROYAL SOCIETY OF MEDICINE (Electro-Therapeutics Section), at 8.30.—Prof. W. D. Halliburton: Physiological Advance: The Importance of the Infinitely Little (The Mackenzie-Davidson Memorial Lecture).

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Sir Frederick Bridge: The Researches of a Musical Antiquarian.

SATURDAY, MARCH 19.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir Ernest Rutherford: Electricity and Matter.

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