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The Genesis of the World.

"WHENCE sprang this world, and whether framed
By hand divine or no—"

are questions that have fascinated and perplexed the greatest thinkers of every age, or at least since man reached such a level of intellectual evolution that he could speculate about them. If we may reason from our knowledge of the mentality of the lowest grades of humanity as we know them to-day, it is reasonably certain that man must have existed on the earth for æons before he attained to a degree of mental development that would enable him to give the slightest consideration to such matters. Anthropologists tell us that even in this twentieth century there are races of men, situated in remote and widely separated regions of the world, who have never framed, and, so far as can be discovered, have never attempted to frame, any conception or surmise concerning its origin. And yet these races are as far removed in development from the prehistoric man as the prehistoric man was from the ape.

It is nevertheless true that thousands of years before the beginning of our era there were some whose mental powers enabled them to ponder upon the problem, and to attempt to form the beginnings of a theory of creation which should in some measure satisfy their curiosity and reasoning faculty. But these people existed comparatively late in the history of mankind, and still later in the history of the world. We are apt to think that the legends of Brahma, the spirit who created by his will and the mere exercise of thought the primeval water, the primordial element out of which the world was fashioned, date from the remotest periods of antiquity. This is not so, as we now reckon the age of the world, or the time that man has existed upon it.

It is far from our present purpose to attempt to trace, however slightly, the broad outlines of the growth of knowledge and speculation concerning the genesis of the world—from the myths of primitive races down to our times, when the great enigma is being attacked by modern methods of research and in the light of contemporary science. The subject is too vast to be handled within the narrow confines of an article such as this. But it may be worth noting how characteristic is the difference between the modern methods and the old. The earliest cosmogonies were based upon conceptions which were really incompatible with the experiences of those who framed them. These conceptions must have been repugnant to the intelligence of all who were alive to the teachings of natural phenomena, or refused to blind their reason at the behests of the priests by whom the myths were devised. In one respect the speculations, or at least some of them, may be said to be so far scientific in that they contain the germ of the theory of evolution. But they all presupposed the action or intervention of supernatural forces, and as such had no real scientific basis. Purely metaphysical speculation leads nowhere, and the unsubstantial subtleties of dialecticians leave us cold. We seek to elucidate what has been for countless ages an inscrutable problem in the light of the lessons of physical science. We reason from the facts of astronomy, geology, physics, chemistry, and biology as we know and understand them, and as each new development arises we apply its teaching to the solution of the mystery. It has already been pointed out that the application of the mechanical theory of heat, spectrum analysis, thermal radiation, radiation pressure, and radio-activity to cosmogonic phenomena has done more to elucidate these problems than all the speculative theories and systems of former ages put together.

The lecture [1] which Prof. Nernst reprints in the little brochure before us is, we believe, the latest attempt to focus the outcome of modern research upon this question of the origin and mode of formation of the world. He applies to it the knowledge with which his study and training as a worker and expositor of chemical physics has equipped him. Furthermore, he has sought the aid of students in fields of inquiry other than his own when these have any direct relation to his subject. The lecture was originally delivered in Berlin as one of a series of popular discourses arranged by the Prussian Academy of Sciences about a year ago, and has been repeated in parts of mid-Europe, notably in Vienna and in Prague. As published it has been considerably enlarged. It is prefaced by a short introductory statement defining the problem and explaining its limitations, and the methods by which it may be attacked. It is furnished with a long appendix, practically as extensive as the lecture itself, in which details are developed which would be out of place in a purely popular exposition. As may be anticipated, the whole is instructive and highly suggestive, and we have read it with interest and pleasure. Nevertheless we rise from its perusal with a humbling sense of the inadequacy of our present means to grapple with so stupendous a problem. More than ten years ago the same theme was handled by Prof. Svante Arrhenius in his "Werden der Welten" and afterwards in "The Life of the Universe," and it may be doubted whether in reality Prof. Nernst has succeeded in carrying the matter any further. How partial and inadequate is the basis on which even the latest cosmogony rests was well brought out in the discussion last year at the Edinburgh meeting of the British Association on the age of the earth. The work of one epoch does little more than upset that of its predecessor. Premises in regard to the earth's heat are vitiated by the discovery of radio-active materials. We are still in ignorance as to the true source of solar energy. Secular contraction apparently is not enough to account for it. We have absolutely no definite knowledge on so fundamental a matter. The more we learn the greater seems our ignorance. We can but go on groping for the light, testing our surmises as best we may in the feeble glimmer that our present knowledge sheds.

Negligible as is the scientific merit of the old cosmogonies, they had at least the charms of imagery and fancy—charms at which the cold, unsympathetic eye of a passionless science looks askance. Even the imagination of a Tyndall would find it difficult to invest our modern cosmogony with the vestiges of such attributes.

[1] "Das Weltgebäude im Lichte der Neueren Forschung." Von Prof. Dr. W. Nernst. Pp. iv+63. (Berlin: Julius Springer, 1921.) In Germany, 12 marks; in Great Britain, 48 marks.

Textile Research Fellowships.

THE British Research Association for the Woollen and Worsted Industries represents the culmination of a movement which was started at the University of Leeds during the early days of the war. Two objectives were then in view, research specially applied to the elucidation of problems presented by the textile industries, and a deeper and more extensive education with the object of promoting the introduction of the sciences and scientific method into industry whenever and wherever possible. It was perhaps natural that the first of these objectives should dominate when, in what it conceived to be the larger interest of the community, the University handed over its missionary work to the newly constituted Research Association, which included representatives from the whole of the woollen and worsted industries of Great Britain and Ireland.

The experience of this association is now tending to emphasise the need for well-trained, sympathetic men actually placed in the works if the achievements in research—which already are by no means inconsiderable—are to be used at all: still more is this necessary if anything like full value is to be drawn from research results.

It is therefore not surprising that the research association should consider it not only expedient but also absolutely necessary that well-trained University and other students should be encouraged to resist the more direct call of industry and to prepare themselves for the difficult but very necessary work of introducing more science into industry. Whether this appeal will achieve the desired result depends not only upon the fellows and scholars which the association is now selecting, but also upon the sympathetic consideration given to their work and its possibilities by the controllers of industry. In addition to ability, there must be opportunity, and only the combers, spinners, and manufacturers can give this.

We have confidence that the necessary opportunity will be given to the well-trained man, and we therefore specially direct the attention of those eligible for the fellowships and scholarships offered by the British Research Association for the Woollen and Worsted Industries. In each case awards are tenable in the first place for one year, and maintenance grants are offered, the maximum value of the fellowships being fixed at 200*l*. per annum. Applications for fellowships, which should reach the secretary of the association at Torridon, Headingley, Leeds, before June 30, should contain full particulars of the candidates' training and an outline of the research which it is proposed to undertake. It should be realised, however, that if success is to be achieved a type of "researcher" different from any yet produced is necessary. The man of science has as yet made little or no direct impression upon the woollen and worsted industries; all the advances made —and these have been more considerable than most people realise at the present moment—have been at the hands of the technologist. Indeed, it is still a moot point as to whether the technologist should be encouraged to obtain a training in pure science, or whether the man of science should become a technologist. Possibly both these lines of action are promising, but from the scientific point of view it is very desirable that prospective candidates should have a sound knowledge of the industry, for with this knowledge and deeper insight will undoubtedly come a profound respect for an industry which has already achieved so much, and further an earnest desire to help towards increasing its usefulness in the service of humanity.

Possibly the textile industries offer most promising fields of research in the direction of physical chemistry; but applied mathematics, chemistry, zoology, and other of the sciences have also claims which will certainly not be ignored.

A Manual of Tides.

Tides and Tidal Streams: A Manual compiled for the Use of Seamen. By Comdr. H. D. Warburg, R.N. Pp. vii+95. (Cambridge: At the University Press, 1922.) 8*s*. 6*d*. net.

THE author of this manual is convinced, and not without cause, that the non-harmonic methods of giving and using tidal information at ports not served by complete predictions are obsolete and not trustworthy. These methods assume the simple phenomenon of semi-diurnal tides only and came into prominence because the original workers on tides were most familiar with the tides in European waters. But in most parts of the world the diurnal tides cannot be neglected, even if they are not of greater importance than the semi-diurnal tides, and at present navigators are not provided with information suitable for the calculation of tidal heights in such places. Commander Warburg suggests that the tides should be represented universally by a few harmonic constituents, and that navigators should be taught suitable methods for getting approximate values of the height of tide at any time by the use of harmonic methods.

The author gives an explanation of the generation of tides and tidal currents as an introduction to the harmonic methods proposed, and he also explains various tidal phenomena such as the double high-waters experienced on the south coast of England, but these explanations cannot always be commended from the scientific point of view. The phenomenon of double high-waters, incorrectly explained in the manual, has often been explained correctly from Airy onwards (*e.g.* Sir W. Thomson, NATURE, Dec. 19, 1878), but the wrong explanation is curiously persistent. It is alleged that the cause is in the reflection of the tide wave from the north coast of France and that this "reflected wave" arrives on the south coast of England some six hours later than the "primary wave"; we thus get, it is said, two waves with their maxima some six hours apart and therefore two high-waters within six hours of one another. But obviously, or at least from simple trigonometry, two semi-diurnal oscillations, whatever be their relative phases, can only combine to give a semi-diurnal oscillation; that is, the part played by reflection is to make the resultant phase of the actual oscillation at a given place different from what it would have been if no reflection had taken place. The true cause is the presence of quarter-diurnal oscillations in the primary wave. These are due chiefly to shallow water, and with a free unreflected progressive wave the phases of the semi-diurnal and quarter-diurnal oscillations are such that double high-waters cannot occur; but if reflection takes place then it is possible to disturb this phase relationship so that the minimum of the resultant quarter-diurnal tide occurs about the time of maximum of the semi-diurnal tide; we may then get a "double-headed tide," or a very long "stand." The importance of the shallow-water constituent is, however, not limited to double high-water phenomena, which are only extreme cases.

A brief explanation of the mechanical harmonic method of calculating predictions is given, but the diagram of a tide-predicting machine, however, illustrates motions which are not strictly harmonic. The author might justly complain that a similar diagram has been allowed to pass for several years without comment in the Admiralty Tide Tables!

For the calculation of approximate predictions Van der Stok's scheme of calculation is explained and used in the book, and the calculations are facilitated by appropriate tables. Some little confusion is caused, however, by using the same symbol (k) for the phase-lag (in degrees) and time-lag (in hours) when the tidal constituent is referred to a fictitious satellite; it is customary to use κ for the phase-lag. It is doubtful whether it was wise to depart from the usual rule of stating the astronomical argument; it is customary to make the speeds positive and the arguments therefore increase with time. Except to those using the harmonic method for the first time there is a liability of confusion between theory and practice, a positive speed and a decreasing argument being difficult to reconcile. If, however, the instructions are carefully followed the required predictions can be readily obtained, whether there is much or little diurnal tide.

It ought to be added that a criterion given for the relation between semi-diurnal and diurnal tides so that one maximum per day only can occur, has a very limited application.

The manual gives authoritative explanations of the non-harmonic methods of collecting and using tidal information. In spite of the blemishes mentioned above, the book should serve a useful purpose in making seamen acquainted with the reasons why such methods are often futile. At the same time, it provides an alternative and more exact method, and in doing this Commander Warburg has initiated a movement which, we hope, will lead to much-needed reforms in the everyday applications of tidal science.

A. T. DOODSON.

Electrothermic Processes in Steel Manufacture.

The Electro-Metallurgy of Steel. By C. C. Gow. (A Treatise of Electro-Chemistry. Edited by Bertram Blount.) Pp. xvi+351. (London: Constable and Co., Ltd., 1921.) 27*s.* 6*d.*

WHAT are usually called electro-metallurgical processes of steel manufacture now constitute an applied science of considerable industrial importance. Strictly speaking, however, the processes are not electro-metallurgical since electrolysis is not an essential feature. Electrical energy is transformed into heat energy which is applied to the making and refining of steel of many types. The possibility of applying electrical energy in this way was first demonstrated by the late Sir William Siemens almost twenty years before its commercial possibilities were recognised by later investigators. Prior to the outbreak of the late war the electric furnace had only a very limited application in steel metallurgy. Since then it has had a rapid and vast development, due partly to the shortage of high-grade raw materials, partly to the enormous demand for alloy steels, and partly to the need for utilising in some way the vast accumulation of heavy steel turnings. These conditions presented an exceptional opportunity for the electric furnace, and it was only then that its economic advantages in certain branches of steel-making were actually demonstrated. According to Mr. D. F. Campbell, who has written a preface to Mr. Gow's book, the electric furnace is now absorbing millions of electrical horse-power for various purposes and has produced more than a million tons of steels of various types.

Mr. Gow is well fitted to write a book on electrothermic processes of steel manufacture, both on account of his scientific training and his wide experience of steel works practice. These qualifications have stood him in good stead in producing a book which should attract the attention both of students of metallurgy and practical steel-makers. Following an introductory chapter on the historical development of electric steel furnaces, the early chapters deal with the general principles and application of alternating currents. In writing these the author expresses his great indebtedness to Mr. R. P. Abel. Then come chapters on electrothermal methods of melting and refining cold charges and refining liquid steel, and these in their turn are followed by a chapter on ingot casting. Later chapters deal with characteristic principles and features of electric furnace design and modern types of furnaces, suitable refractory materials, and the properties and manufacture of carbon electrodes. Finally, there is an appendix detailing rapid methods of analysis of bath samples.

The melting of steel on a large scale in a strictly reducing atmosphere is possible only in the electric furnace. New phenomena are observed and striking results have been obtained. It is therefore correct to say that the electric furnace gives the steel-maker and refiner a new atmosphere in which to conduct his operations. Owing primarily to the much higher temperatures which can be reached, steels of inferior grade can be melted and their deleterious constituents to a great extent removed, because it is possible to introduce refining slags which can be fused and operated only at temperatures reached in the electric furnace. This type of furnace has now rendered available new alloys of special value, such as low carbon ferro-chromium, and high-grade ferro-silicon, which in their turn have been economically transformed into products such as stainless steel, stainless iron, and transformer iron. The use of the last named has increased the efficiency of electric transformers to an extent which represents an annual saving of hundreds of thousands of tons of coal per annum.

At one time the induction furnace received considerably greater prominence than the arc furnace. As the author states, many furnace designers, believing that the principle of induction heating was superior, concentrated their efforts on the production of a furnace which could operate on any standard electric supply and at the same time meet all the requirements of the steel-maker. The position to-day, however, is that almost the entire output of electric steel is made from arc furnaces. The book is clearly printed and well illustrated and will certainly repay study by all those interested in the subject.

Physiology of the Growing Plant.

Encyclopédie scientifique: Bibliothèque de Physiologie et de Pathologie végétales: Nutrition de la plante. Par M. Molliard. I. Echanges d'eau et des substances minérales. Pp. xiv+395. II. Formation des substances terraires. Pp. vi+438. (Paris: Gaston Doin, 1921.) 14 francs each vol.

A SERIES dealing with the physiology of the growing plant in health and disease is being written by Prof. Molliard, Dean of the Faculty of Science of the University of Paris, and the two volumes under notice are the first to be issued. The scope of the series is wider than would usually be undertaken by a single writer, but the author considers that the advantages of uniform treatment will outweigh the disadvantages arising from the attempt to cover so extensive a field of science.

The volumes before us deal with the nutrition of the plant, the phenomena of absorption of nutrients from the soil, the building up of complex substances in the plant and their translocation from leaves to storage organs. The author has succeeded in bringing together a great amount of material that cannot usually be found in the same book, and this will prove a convenience to students. As an example, under the heading "Glucosides" there is not only the usual chemical account of these substances, but illustrations of cross-sections showing the distribution of typical glucosides in growing plants. In this and in other directions, the volumes give to the chemist much information that he does not possess although it may be well known to the botanist, and they give to the botanist a survey of chemical relationships which he might not find so easily elsewhere.

It could scarcely be expected that a book covering so much ground could include anything like all the recent work. The section on soils, for example, contains no reference to many of the investigations made during the last few years. The only grouping of fractions in mechanical analysis of which mention is made is that of Wollny, drawn up forty years ago, no reference being made to the important later developments made in the United States, Great Britain, Sweden, or elsewhere. Similarly also, it is assumed that soil possesses the sand-grain structure formerly attributed to it, although this view is now displaced by the later colloidal hypothesis. Fuller justice is done, however, to recent French work, and it is in the summaries of some of these interesting and suggestive investigations that English readers will find the chief interest of the book.

We should like to suggest that in future volumes there should be more references showing the sources from which the tables are taken. A considerable number of figures are given, but it is not easy to know the exact conditions under which they were obtained, and, as every one who has studied plant nutrition is aware, the phenomena are profoundly affected by alterations in the conditions under which the plant is growing. In particular the section dealing with the mineral constituents of plants would have been greatly improved by fuller references.

Life among the Sema Nagas.

The Sema Nagas. By J. H. Hutton. Published by the direction of the Assam Government. Pp. xviii+463. (London: Macmillan and Co., Ltd., 1921.) 40*s.* net.

MR. HUTTON has quickly added to his monograph on the Angami Nagas a second describing the allied tribe, the Sema. The latter occupy the watershed dividing Assam from Burma, the plateau and the valleys of three rivers, the most important, the Dayang, eventually flowing into the Brahmaputra and so into the Ganges, the other two mingling their waters with the Lania, and reaching the sea by way of the Ti-Ho, the Chindwin, and the Irawadi. The Sema Nagas are a mixed race, the result of emigration from at least three directions: from the north-west, whence came the Singpos, Kacharis, and Garos; from the south the Angamis; while a migration from south northwards on the part of the Thado Kukis and Lusheis has scarcely ceased even now.

Mr. Hutton's work is the result of eight years' acquaintance with the Sema Nagas, during which he learned to speak their language, which had not hitherto been reduced to writing, and gained the confidence of a semi-savage people. He has thus had the opportunity of producing a fine, original work in ethnography, his memoirs being more elaborate than the other volumes of this excellent series which we owe to the enterprise and liberality of the Government of Assam.

Previous writers have found little that is favourable in the character of the Sema, and speak of their cruelty in war, their treachery and habit of lying. But Mr. Hutton, himself an Irishman, describes them as the Irishmen of the Naga race, generous, hospitable, and frequently improvident, impulsive and cheery, if easily depressed quickly regaining their spirits, readily moved to laughter and merriment under the most unpleasant conditions, while they still preserve a strong vein of fatalism. Their physical endurance in carrying heavy loads for long distances, in bearing cold and exposure, is remarkable, and in warfare and hunting, at any rate by Naga standards, they are plucky and daring. Their women, in appearance stumpy, plain or even ugly, are cheerful, faithful wives and dutiful daughters. Their art is limited to the decoration of their dress, weapons, and the Genna posts which mark the taboo limits of their villages.

As is usually the case with semi-savage tribes, the Sema live under a rigorous system of taboos, much more restrictive than those of the Hindu caste system. This type of taboo, known as Genna, is largely regulated by the agricultural seasons, and is enforced at sowing, harvest, and other farming operations. On such occasions work is suspended and special diet with numerous other trivial restrictions is enforced. They believe in a Creator, vaguely conceived, who interferes little in the affairs of men, in spirits of the sky and of the wild, spirits which cause delirium, spoil the crops and breed strife and quarrels, the spirits of the dead which fetch the living when they die. The basis of society is not the tribe or the clan, but the village, and they have evolved an elaborate system of social law. They manufacture for their own use excellent cotton cloth, not using fibres as the Angami do. Iron work is of recent introduction and follows methods borrowed from adjoining tribes. In spite of this advancement in social and industrial culture, head-hunting, success in which entitles the hero to wear gauntlets decorated with cowry shells and a collar of pigs' tushes, prevails, and the heads of women are specially valued, probably because they are secured with difficulty, women working only near the village in time of danger.

Mr. Hutton has described this strange type of society with wide knowledge and sympathy. His book is comprehensive, well arranged and supplied with maps and illustrations. Mr. H. Balfour, who writes a foreword, does full justice to it as an ethnographical study, and he informs us that Mr. Hutton has liberally presented to the Pitt Rivers Museum the greater part of his fine collections, an important gift to his old University.

More Books on Relativity.

A Criticism of Einstein and his Problem. By W. H. V. Reade. Pp. vi + 126. (Oxford: B. Blackwell, 1922.) 4*s*. 6*d*. net.

Relativity for All. By Herbert Dingle. Pp. viii + 72. (London: Methuen and Co., Ltd., 1922.) 2*s*. net.

Einstein and the Universe: A Popular Exposition of the Famous Theory. By Charles Nordmann. Translated by Joseph M'Cabe. Pp. 185. (London: T. Fisher Unwin, Ltd., 1922.) 10*s*. 6*d*. net.

Le Principe de Relativité et la Théorie de la Gravitation. Leçons professées en 1921 et 1922 à l'École polytechnique et au Muséum d'Histoire naturelle. Par Prof. J. Becquerel. Pp. ix + 342. (Paris: Gauthier-Villars et Cie, 1922.) 25 francs.

La Théorie einsteinienne de la Gravitation: Essai de vulgarisation de la théorie. Par Prof. Gustave Mie. Ouvrage traduit de l'allemand. Pp. xi + 119. (Paris: J. Hermann, 1922.) 4·50 francs.

L'Éther actuel et ses précurseurs (simple récit). Par E. M. Lémeray. Préface de L. Lecorme. Pp. ix + 141. (Paris: Gauthier-Villars et Cie, 1922.)

Raum und Zeit im Lichte der speziellen Relativitätstheorie. Versuch eines synthetischen Aufbaus der speziellen Relatitivätstheorie. Von Dr. C. Von Horvath. Pp. v + 58. (Berlin: Julius Springer, 1921.) England, 36 marks; Germany, 12 marks.

THE stream continues. Here are seven more books on relativity. It is difficult to know where to begin in commenting on such a collection. Mr. Reade's perhaps may be dismissed with a word; it ought not to have been written. Mr. Dingle's, on the other hand, is a serious little book by one who has caught the spirit of the matter. Within the limits of seventy small pages, without any mathematical symbols, he has done as well as can be expected in suggesting the various strains of thought that go to the making up of the theory. It is neither extravagant nor childish; it gives enough and not too much emphasis to illustrative analogies. The reader of this account may be assured that he is not being misled.

M. Nordmann's work, to which Viscount Haldane contributes a preface, is a much more ambitious production than that of Mr. Dingle and calls for more lengthy comment. To quote from the preface:

"The Latin capacity for eliminating abstractness from the description of facts is everywhere apparent. . . . This book could hardly have been written by an Englishman. The difficulty in his way would have been one as much of spirit as of letter. It is the lucidity of the French author, in combination with his own gift of expression, that has made it possible for the translator to succeed so well in overcoming the obstacles to giving the exposition in our own tongue this book contains. The rendering seems to me, after reading the book both in French and in English, admirable."

The book is certainly readable. The language is not only clear, but also picturesque. "Einstein may be a treasure, but there is a fearsome troop of mathematical reptiles keeping inquisitive folk away from it. Let us drive them off with the whip of simple terminology, and approach the splendour of Einstein's theory." This is the author's intention, like that of many others; how does he succeed?

In the first two chapters we may admit a considerable success. Here due recognition is given to the valuable work done by Poincaré in preparing the minds of physicists for the theory by his insistence on the relativity of space. The reader is brought to the point of seeing the confusion wrought by the unexpected result of the Michelson-Morley experiment.

At the third chapter the author begins to feel the excitement of Einstein's new thoughts, and gives us a version of the explanation advanced in 1905 of the true significance of the Fitzgerald contraction-hypothesis. With the gesture of a conjurer he produces a "simple" version of Einstein's argument, remarking, however, that its elementary simplicity has not been attained without difficulty. Unfortunately the explanation advanced has nothing whatever to do with the argument of Einstein or the Fitzgerald hypothesis, but refers to the first order effect which would arise if the old theory were true. Later in the chapter the footnote giving as the best definition of the second, "the time which light takes to cover 186,000 miles in empty space, far from any strong gravitational field" suggests again quite a wrong view to the unwary and inexperienced reader. In spite, however, of these inaccuracies the writer does convey something of the impression of the insufficiency of the old absolute time and space ideas, and describes the situation thus: "We have before our eyes merely a battlefield strewn with corpses and ruins." "Time and space lie, torn and crumbled, among the rubbish of ancient theories."

Now comes the task of describing in "simple terminology" the work of reconstruction. The reader must judge whether the following is simpler than a brief algebraic equation: "The distance in time and the distance in space are numerically to each other as the hypotenuse and another side of a rectangular triangle are to the third side, which remains invariable. Taking this third side for base, the other two will describe above it, a triangle more or less elevated according as the velocity of the observer is more or less reduced. This fixed base is a quantity independent of the velocity. It is this which Einstein has called the '*Interval*' of events." A few lines later we read that this interval is the "sole perceptible part of the real. Apart from it there is nothing we can know." With this the writer passes on to the next chapter. Here the mechanics arising out of the restricted principle of relativity is described clearly and without rhetoric.

We have now to see how the author deals with the generalised relativity and its consequences. If the reader has digested the idea of interval so rawly presented to him in the early chapter, and has not the quickness to perceive that this has not been extended to the generalised theory, he may get a general impression from the next two chapters which is of the right type, but which again is far from accurate in detail. It appears from the account given that the only new feature in this stage is the introduction of gravitation. Not a word is said about the application of the general doctrine that all physical laws must have a form which is independent of the arbitrary choice of variables in the four-dimensional continuum. The mathematical reptiles are certainly driven off, and the treasure is not only left unguarded but it disappears. What is left is not the genuine article. Here again there are inaccurate statements, *e.g.* "the universe is not Euclidean because in it light does not travel in a straight line."

It is no pleasure to write thus critically of a valiant attempt to bring this theory into a form suitable for the layman. It is a supremely difficult task that is being attempted by so many writers. M. Nordmann is well equipped in many ways for it. But he has fallen into the very common error of supposing that the essential truth can be given while omitting the demand for concentrated thinking on vital details. The world suffers far too much from loose thinking already. Vague generalisations, misleading analogies, superficial manifestations are made to do duty for precise statements, logical reasoning, and fundamental principles. It is not necessarily true that mathematical skill is the only way of approach to an understanding of Einstein's fundamental ideas. But it is certain that if such an understanding is to be reached it can only be by going down to a patient analysis of our own preconceived notions until we find them insufficient. Einstein's success has come from a deep-rooted conviction that those thinkers were right who would not admit that a point in empty space could be labelled "stationary" or "moving uniformly in a straight line." He followed the logic of his conviction and achieved fame. It was accuracy and honesty of thought which carried him through.

Prof. Becquerel gives us a text-book of the whole matter for those who are prepared to go into the complete mathematical presentation. There is nothing original; it is a plain and unvarnished account of the theory as it stands, including the generalisations of Eddington and Weyl. We may note that the author adopts the general conclusion that the gravitational field is the manifestation of the non-Euclidean character of the structure of the Universe, and that mechanics and physics are reduced to geometry. Is it not time that this statement should be examined more carefully? It suggests that the cart is pulling the horse and that the concrete arises out of the abstract, the known out of the unknown. When the physicist lapses into metaphysics he is apt to leave his terms undefined.

Of the remaining books before us we may briefly say that Prof. Mie's is a French translation of a German pamphlet recently noticed in these columns, that M. Lémeray traces the history of the rise and fall and ultimate extinction (as he seems to consider it) of the idea of the "ether," and that Dr. von Horvath has thought it well to try to give a new presentation of the restricted principle of relativity.

E. Cunningham.

Principles of Spectacle Design.

Handbuch der gesamten Augenheilkunde. Begründet von A. Graefe und Th. Saemisch, fortgeführt von C. Hess. Herausgegeben von Th. Axenfeld und A. Elschnig. Dritte, neubearbeitete Auflage. *Die Brille als optisches Instrument.* Von Prof. Dr. M. von Rohr. Dritte Auflage. Pp. xiv+254. (Berlin: J. Springer, 1921.) In Germany, 66 marks; in England, 132 marks.

SINCE the first edition of this work appeared ten years ago, the design of spectacles has undergone important developments which are attributed by the author to the increased competition of large specialist manufacturers, to the interest of ophthalmologists and technical scientific workers, and to recent war experience.

The work is worthily dedicated to Allvar Gullstrand, upon whose optical treatment of the subject the theoretical portions are based, and more particularly those sections concerned with the eye in motion. It deals in a thorough and comprehensive manner with the comparatively simple geometrical principles involved in the design of spectacles for the correction of abnormal vision, but, as is clearly stated in the preface, it does not enter the sphere of the optical computer to whom the practical design is entrusted.

Those who are interested in the theoretical problems of spectacle design will find in this work a clear exposition of most aspects of the subject. The formulæ as well as the diagrams can be relied upon, as they are particularly free from errors. An introductory section deals with spectacles of various materials for special purposes. Section I. is devoted to anastigmatic lenses for both fixed and moving eyes. Section II. deals with astigmatic lenses, under which are included the various toric forms and combinations. In Section III. chromatic aberrations are considered, and apparent aberrations in the image space resulting from vision through spectacles are discussed in the concluding section. Although excellent source, name, and subject indexes are provided, there is unfortunately no index of the symbols employed. The systematic historical index of the first edition has been dispensed with, as the information is included under the various subject headings.

Nearly one-half of the text is devoted to historical references which increase the general interest of the work. As the author states in his preface, the desire to recognise the true inventor lies close to his heart. The task is a difficult one, and, if the author has failed in some respects, it may be attributed to a too ready use of German sources of information. The historical notes do not extend much beyond 1917, although, according to the title-page, the edition dated 1921 is stated to have been newly revised. Indeed, there is only one reference as recent as 1920. An English author is pilloried (p. 114) for the absurd accuracy of certain numerical data, but the author himself, in many instances records to within 1/1000 mm. ocular dimensions that are comparatively indefinite.

There is a tendency throughout the work to sacrifice clearness to generality. Spectacles, for example, are inadequately defined as "optical instruments that can be carried continuously before the eyes," the object being not to exclude extreme cases such as protective glasses for stone-hewers, spectacles for drivers, and those in which use is made of mica, horn, and other substances. But the reader will find more in this book by Dr. M. von Rohr for warm approval rather than for criticism.

James Weir French.

Our Bookshelf.

A Manual of Determinative Mineralogy. By Prof. J. Volney Lewis. Third, revised and enlarged edition. Pp. v+298. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1921.) 16*s.* 6*d.* net.

We have here an excellent guide to the recognition of mineral species. It is not intended to supersede the use of a standard work on mineralogy, but to train a student to acquire a first-hand knowledge of minerals and their distinguishing characters and ultimately a facility in identifying the commoner species at sight. There is a general classification occupying more than 130 octavo pages based on physical characters, especially streak, colour, and hardness, in the order named. After a rather full account of blow-pipe and other convenient chemical tests, including some which are not commonly employed in this country, there is another classificatory table of 70 pages constructed to assist in the identification of minerals by this means. This is followed by a third table based on the crystalline system and hardness. Perhaps greater stress might have been laid on specific gravity, the determination of which is frequently one of the most rapid means of "running down" a doubtful mineral. Also no mention is made of the use of a permanent horseshoe magnet with special adjustable poles by the help of which the comparatively weak magnetic character of minerals like monazite can be easily recognised even in the field. J. W. E.

(1) *Botany for Students of Medicine and Pharmacy.* By Prof. F. E. Fritch and Dr. E. J. Salisbury. Pp. xiv + 357. (London: G. Bell and Sons, Ltd., 1921.) 10s. 6d. net.

(2) *Junior Botany.* By T. W. Woodhead. Pp. 210. (Oxford: Clarendon Press, 1922.) 3s. 6d. net.

(3) *The Elements of Vegetable Histology.* By Prof. C. W. Ballard. Pp. xiv + 246. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1921.) 18s. net.

(1) Prof. Fritch and Dr. Salisbury have prepared an elementary text-book, which is stated in the preface to be for the use of students of medicine and pharmacy. A large number of new figures of plant structures are produced, and many of them will form a useful addition to botanical illustration. A few, however, such as Figs. 69 and 71, are too diagrammatic, sketchy, or ragged to be desirable for elementary students, and of course they are of no use for any other purpose. The book begins with the plant as a whole, using the Shepherd's-purse as type. It goes on with several chapters on the various plant organs and their functions. The chapter on plant cells concludes with an account of protoplasm in colloidal terms. Growing points, tissues, cell contents, and the structure of roots, stems, and leaves are then carefully treated, followed by physiology and the study of types. The book ends with a chapter on heredity and evolution, and an appendix dealing with reagents and methods. It covers adequately the syllabus for medical students and is one of the best we have seen for this purpose, but it is questionable if a somewhat more biological and scientifically imaginative treatment of the subject would not be to the advantage of elementary botanical teaching.

(2) The second volume under notice is a neatly produced little book of more elementary character, and well illustrated, the 140 figures being new with one exception. It begins with a chapter on the garden stock, followed by condensed treatment of seeds and germination, roots and their function, the shoot and its physiology, hibernation and movement in plants. The second part deals with the structure and biology of the flower, including pollination, fruits, dispersal, etc. Every beginning student would find it useful, particularly for its studies of flowers and fruits, and the price is very moderate.

(3) The only features we can recommend in Prof. Ballard's book are the paper and binding, and the first and the last chapters, dealing with the structure and use of the microscope and its accessories. The body of the work is too crude, even for the pharmacy students for which it is intended, to deserve the name of botany. A single quotation from p. 122 will be sufficient to indicate how many errors can be packed into one sentence. "Communication between the various cells forming a tracheid is effected by means of pores in the vessel walls." The illustrations can only be characterised as for the most part very poor. Fig. 29 is intended to illustrate mitosis, and is stated to be "modified" from Strasburger's text-book. The drawings are almost caricatures. They show centrosomes where none exist, and the name "polar bodies" is given to them! It is a disservice to botanical science to publish a book of this character. R. R. G.

The Autonomic Nervous System. By Prof. J. N. Langley. Part I. Pp. viii + 80. (Cambridge: W. Heffer and Sons, Ltd., 1921.) 5s. net.

THE present small volume gives a very useful summary, clearly and concisely written, of the present position of our knowledge of the subject of which it treats. The author divides the peripheral nerves into somatic and autonomic, and the latter into sympathetic (thoracico-lumbar, to all regions of the body), enteric (plexuses of Auerbach and Meissner), and parasympathetic, which is again divided into tectal (or ocular, supplying the sphincter of the iris and the ciliary muscle), bulbar (alimentary canal from nose and mouth to large intestine, with appendages, including the lungs), and sacral (lower part of large intestine, bladder, and external genitals). The several chapters deal with the divisions of the autonomic system and nomenclature; the general plan of origin and of peripheral distribution; the nerve fibres of the autonomic system; the specific action of drugs on the sympathetic and parasympathetic systems; and the tissues innervated. Each chapter is followed by a bibliography of important papers and by a series of notes.

First Course in the Theory of Equations. By Prof. L. E. Dickson. Pp. vi + 168. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1922.) 8s. 6d. net.

THE introduction to the Theory of Equations contained in this volume is wide enough to cover the needs of all except those who aspire to become mathematical specialists. The methods throughout are strictly elementary, the treatment reaching the algebraic solution of cubic and biquadratic equations without any reference to substitutions or group-theory. Useful chapters on determinants and elimination are included, while another one deals with elementary properties of symmetric functions. The book contains a severe course of computation within the scope of its subject-matter, and a considerable proportion of the abundant examples are numerical in character. Two subjects avoided by most writers of elementary text-books are discussed in a satisfactory and convincing way: (1) the impossibility of trisecting an angle, and (2) the construction of a regular polygon of seventeen sides, by the methods of Euclidean geometry. Prof. Dickson's book possesses all the merits of an excellent text-book, and it is to be hoped that its circulation will be a wide one.

Department of Scientific and Industrial Research: Fuel Research Board. A Handbook on the Winning and the Utilisation of Peat. By A. Hausding. Translated from the Third German Edition by Prof. Hugh Ryan. Pp. xxiii + 506. (London: H.M. Stationery Office, 1921.) 30*s.* net.

An account of some processes for the utilisation of peat, particularly as a fuel, with references to German patents is given in the volume under notice. The mechanical details are better dealt with than the chemistry, which is often ludicrously inaccurate. The translator, indeed, often remarks on the latter point, and on the inaccuracy of the calculations, but makes no attempt to put things right. Some of the illustrations (*e.g.* Figs. 16, 46—which seem to be repeated in 54, 68, 69, 71, etc.) are very poorly reproduced. In spite of obvious defects the book contains a large amount of practical information not otherwise available in English, and will be of value to those interested in peat utilisation. An appendix, giving a reasoned account of the complete failure of some recent schemes, would have been instructive. The statistical information should be compared with that contained in the Final Report of the Nitrogen Products Committee, which is probably more accurate.

The Petroleum Industry: A Brief Survey of the Technology of Petroleum based upon a Course of Lectures given by Members of the Institution of Petroleum Technologists on the occasion of the Petroleum Exhibition, Crystal Palace, 1920. Edited by A. E. Dunstan. Pp. vi + 346. (London: The Institution of Petroleum Technologists, 5 John Street, Adelphi, n.d.) 14*s.* 6*d.*

The petroleum industry is of peculiar interest and importance to the British Empire, and all readers of Nature will welcome the appearance of the present volume. The series of lectures by experts have been carefully co-ordinated, and the result is very readable. All phases of the industry, from the prospecting for oil to the various uses of the finished products, are treated in a way which is a model of lucidity combined with accuracy of detail, and the book cannot fail to be of interest both to the specialist and to the general reader. The illustrations are particularly good. In the opinion of Sir Frederick Black "oil is not likely to supplant coal, but should supplement it"—a wise counsel.

Town Gas Manufacture: A Practical Introductory Treatment of the Equipment and Processes of an Average Gas Works, for Students, Junior Gas Engineers, and others connected with Gas Works. By Ralph Staley. Pp. xii + 108. (London: Sir I. Pitman and Sons, Ltd., 1922.) 2*s.* 6*d.* net.

The scope of this book is sufficiently indicated by its title and sub-title. The accounts of the manufacture of gas coal and water gas, including purification, are brief but clear, and the illustrations are good. There is mention of "great pressure setting up heat" in stacks of coal (p. 6), and "high heats" (pp. 81-82), meaning high temperatures. The account of the reaction in the gas producer is out-of-date, while washing with anthracene oil might have been mentioned as a method of removing "naphthalene, that mysterious bugbear." The fact that carbon monoxide is dangerously poisonous is also worthy of mention to junior gas engineers. The book should be very interesting to students of chemistry as well as to those intending to enter gas works.

A First Book of Chemistry for Students in Junior Technical Schools. By Dr. A. Coulthard. Pp. viii + 156. (London: Sir I. Pitman and Sons, Ltd., 1922.) 4*s.* 6*d.* net.

Dr. Coulthard's book has some features which distinguish it from the scores of "elementary" or "junior" text-books which have appeared in recent years. It is quite up-to-date in its information; the scope is limited but is still sufficient to give a good view of the fundamental laws of chemistry, although the atomic theory is not included, the book finishing with equivalents. In connection with class work and practical work (over a hundred good experiments are described) the book should be found useful, and it may be recommended for use in junior classes. Ten years ago a book of this size would have sold for two shillings at the outside, but the price is probably reasonable nowadays.

Manuel de parfumerie. Par I. Lazennec. (Bibliothèque Professionnelle.) Pp. 281. (Paris: J.-B. Baillière et Fils, 1922.) 8 francs.

M. René Dhommée is editing an encyclopedia of 150 volumes on "travail national," which is intended for French artisans. The idea is good, and corresponds in many ways with that of the "Life and Work" Series now being published by Messrs. Macmillan. The scope of the book is similar to that of Parry's "Perfumes," recently noticed in Nature, but is not quite so full on the scientific side. The technical processes are described in detail, with illustrations, and there are numerous recipes (which are not given by Parry). The book should fulfil its object, and we wish the editor success in his enterprise.

Oils, Fats, and Fuels. By T. Hull. Pp. viii + 143. (London: Blackie and Son, Ltd., 1921.) 3*s.* 6*d.* net.

A very elementary account of the subject suitable for students in technical schools and classes will be found in this book. The chemistry of the materials and processes are not dealt with, formulæ and equations being purposely omitted. There is no index. On p. 128 the composition of "modern coal gas" is given as containing only 8 per cent. of carbon monoxide and 3·5 of "oxygen, nitrogen, etc." This must refer to genuine coal gas and not to the "modern" variety. No mention of fat hardening is made.

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.*]

Geology and the Nebular Theory.

THE literature of geology has grown so immense that no man can be familiar with all of it, particularly when it refers to another continent than one's own, yet it comes as a surprise to a Canadian to find eminent Old World geologists still referring to the nebular hypothesis as an established fact of geological history. A few weeks ago Prof. J. W. Gregory suggested that life began on mountains, since these were the first parts of the earth's crust to cool to a suitable temperature, and more recently Prof. Joly, in discussing the age of the earth, assumes the truth of the nebular hypothesis, though he admits that "there was indeed some scanty sedimentation in Archæan times."

Probably no country includes a larger area of Archæan rocks than Canada, and several parts of the area have been studied as carefully as possible because of their importance as mining regions, yet no evidence of a hot earth has been found. The Huronian rocks of cobalt include a glacial deposit which is known to have covered many thousands of square miles. The Sudbury or Timiskaming Series, next in age, consists almost entirely of sediments, such as boulder conglomerates which may be glacial, arkosi with unweathered feldspars, and graywacke with seasonal leanding. Near Sudbury the series has a thickness of more than 20,000 feet.

The oldest rocks of all are the Keewatin and the Grenville Series, the former consisting mainly of volcanics but including thousands of feet of sedimentary gneisses and of "iron formation"; the latter is made up wholly of sediments, reaching a thickness of more than 50,000 feet in places and containing immense deposits of limestone, as well as much carbon in the form of graphite.

It might be thought that the Keewatin lavas imply a hot condition of the earth, but as a fact most of them exhibit pillow structure, showing that they were poured out into water. Liquid water existed over many thousands of square miles, and probably the temperature was low enough for the life of algæ and perhaps of primitive animals, as suggested by the carbon and limestone. The rocks of this most ancient known geological period do not indicate a higher temperature than that of later times.

It is probable, however, that those geologists who think of the earth as hot in Archæan times have in mind the granites and gneisses which underlie the most ancient sediments, the Laurentian rocks of Canada and similar plutonic rocks of other countries, which undoubtedly are of eruptive origin, and have been described as part of the original crust of the molten earth. In reality the Laurentian batholiths are far younger than the sediments and volcanics of the Keewatin and Grenville which they have invaded, and a similar welling-up of plutonic batholiths has occurred at numerous times in the later history of the world, and is perhaps still taking place beneath great ranges of youthful mountains like the Andes and Himalayas.

The coast range of British Columbia, 1100 miles long and 100 broad, consists of just as characteristic batholithic rocks as the Laurentian, but is of Jurassic age, and the Andes, which are still younger, appear to be largely of the same character. Granite and gneiss may be of any age, and do not imply a cooling earth as some have supposed. We find greater areas of such plutonic rocks in the most ancient geological periods simply because they have been exposed to denudation for a longer time, and so have been more widely uncovered.

The conditions found in the Archæan of Canada are repeated in Brazil, India, and Scotland, and probably other countries of which the present writer has no personal knowledge. The oldest rocks in the world are sedimentary and indicate temperatures like those of later times. If the earth was ever a molten sphere, there is no evidence of this condition in the geological record, and geologists should not cling to an outworn theory which the astronomers themselves have largely given up. In the planetesimal theory a method of world building has been provided which permits of a cold surface from the beginning, and fits far better with the known geological facts than the nebular theory.

A. P. COLEMAN.
University of Toronto, Toronto, Canada, May 16.

Species and Adaptations.

MR. BATESON's address to the American Association at Toronto last December, which was published in NATURE of April 29, exhibits features of the same kind as those which were evident in his address to the British Association in Australia in 1914. In the Australian address he maintained that the effect of the discoveries and investigations in recent years in the phenomena of heredity and variation was greatly to increase the difficulty of understanding the origin of any characters which were new in the proper sense of the word. He went so far as to suggest that all characters which have appeared in the course of evolution may have been present in the protoplasm or nuclear structure of the original unicellular forms from which later forms, including man, have descended, all apparently new characters having been due to loss of inhibiting factors and segregation of various simpler combinations from the original complex. Now Mr. Bateson again declares himself an agnostic with regard to the evolution of species, and in spite of all modern discoveries, or because of them, states that we are farther than ever from any satisfactory explanation of the evolution of a new species, or of two or more species, from a single ancestral species.

Mr. Bateson admits that plenty of Mendelian combinations would in nature be given specific rank, and then proceeds to state that the topic of evolution is now dropped in genetical circles. He then illustrates the rule of silence on this favourite subject of a former generation by devoting the rest of his discourse to it, only to lead up to the conclusion that specific difference probably "attaches" to a base of which we know absolutely nothing at all. Our faith in evolution, Mr. Bateson declares, is unshaken; our doubts are merely as to the origin of *species*.

Now I have no intention of stating in opposition to Mr. Bateson that our present knowledge fully explains the origin of new species; I wish merely to offer some criticisms of the difficulties which he describes. In the first place, I dislike the expression "faith in evolution." I do not share the distrust in facts and reasoning which is now in vogue as a reaction against the excessive confidence of the nineteenth century. Evolution is a question of science, of verifiable facts and sound reasoning, and has nothing to do with faith. Mr. Bateson himself in another paragraph states that we have absolute certainty that new forms of life, new orders and new species, have arisen on the earth. The explanation is the difficulty, but we have ample evidence that organisms, whatever their characters, are only produced by reproduction from parents.

One is tempted to conclude that Mr. Bateson attaches some mystical meaning to the word "species." He says we have no reason to suppose that any accumulation of characters of the same order as those met with in genetical experiments would culminate in the production of distinct species. According to him there is some underlying base which is specifically distinct and bears the characters. I fail to see that this idea has any scientific meaning or validity. What is this base? In science we must regard things and phenomena objectively. We distinguish species by characters, just as we distinguish all objects by their qualities. For example, we have the familiar example of single comb and rose comb in fowls. We cannot have singleness and rose-ness without the comb that exhibits these characters. If they occurred in nature, excluding crossing or hybridisation, they would be specific characters, at least in company with other differences they might be. Is the comb then the base? The comb must have some character and shape, and thus we cannot have the comb without a character. We can have the entire absence of comb, as in the allied genus Phasianus; and so with all other characters. This idea of a specific base distinct from specific characters seems merely false metaphysics. How can we conceive of an organism without characters, or characters without an organism? Perhaps Mr. Bateson means that unit characters such as those which can be transferred in Mendelian crosses might all be taken away, and still an organism would be left with non-Mendelian characters. What are these characters? He does not tell us. We have cases of the absence of pigment in, *e.g.*, a bird, then the feathers are left. We may have an organism without feathers, and then the skin is left. We can scarcely have an organism, at any rate a vertebrate, without a skin. On the other hand, we may have factors, whatever their nature, which in the absence of one or more other factors produce no visible character, as in the cases of white varieties of animals and plants which, when bred together, produce coloured offspring. It has been shown that there are several kinds of white varieties or races, the distinguishing characters of which are invisible. Perhaps Mr. Bateson means that species were originally distinct in this way, separated by characters which were non-apparent.

Mr. Bateson insists on the rarity of the occurrence of new dominants under observation in experimental breeding, although new recessives, that is, the loss of particular characters from a combination, are common enough. Even in Drosophila few new dominants have been seen, and none of these could be expected to survive under natural conditions. He further states that in tracing the origin of our domesticated animals and plants we can scarcely ever point to a single wild species as the probable progenitor. Now it seems to me that there is very good evidence that all our breeds of domesticated fowls have descended from *Gallus bankiva*, and in the numerous existing breeds there are many dominant characters which are not present in the wild ancestral form, *e.g.* the dominant white of the White Leghorn, and the rose comb. Mr. Bateson says he cannot imagine such a new dominant character being produced. But surely it is evident that they have been produced in the succession of generations of domestic fowls. Mr. Bateson's difficulty seems to be merely that we do not know how they came into existence. We can, however, scientifically form the conclusion that they originate by some change or development in the chromosomes, not directly dependent on any corresponding external stimulus.

Another reason which Mr. Bateson gives for his scepticism is that the chief attribute of species is that the product of their crosses is frequently sterile. This seems on the face of it illogical. If the sterility is only frequent it follows that there are many cases in which such sterility is absent. In that case, as there are many species which produce fertile offspring, the sterility of species hybrids cannot be the "chief attribute" of species. It is neither a universal nor necessary characteristic, and all we can say is that we do not know how it arises in certain cases. John C. Phillips in America crossed three wild species of duck (*Anas boscas*, *A. tristis*, and *Dafila acuta*) and found the progeny fertile. Bonhote has published the results of numerous similar experiments in this country. The various species of Bovidae also are stated to be fertile *inter se*.

I find it very difficult to understand Mr. Bateson's reasoning on this subject. He states in one place that the fact that hybrids between species are by no means always sterile is a commonplace of everyday experience, and then a little farther on, insists that until the production is witnessed of an indubitably sterile hybrid from completely fertile parents which have arisen from a single common origin, we have no acceptable account of the origin of "species." The two statements contradict each other. Interspecific sterility may be very mysterious, but it has nothing to do with the origin of these species which do not exhibit this sterility. Moreover, there is evidence of the occurrence under observation and experiment of new varieties which are more or less infertile with one another. *Œnothera gigas*, a mutant from *O. Lamarckiana*, shows a great degree of sterility when crossed with other mutants from the same species, and two mutants of Drosophila in Morgan's experiments are almost completely sterile with one another.

It is not very surprising that genetical researches of the Mendelian kind have not thrown much light on the occurrence of variations and mutations, for except in the cases of Œnothera and Drosophila they have usually consisted in analysing by crossing experiments the hereditary factors already present, instead of breeding many generations from a single form and studying the variations that occur. To my own mind, there is no proof that the numerous breeds and varieties of domestic fowls, all descended almost certainly from the single species *Gallus bankiva*, differ in their essential nature from groups of closely allied species and varieties in a natural state.

The feeling, however, that chiefly prompts me to comment upon Mr. Bateson's Toronto address is one of protest against the implied disparagement of those who have not ceased to discuss evolution. There is more in evolution than the origin of species. Mr. Bateson himself has contributed largely to the proof that the distinctions between species have little or nothing to do with adaptation, but at the same time he has failed to realise the true nature and importance of adaptation in itself. In his address he makes no reference at all to adaptation, or to the relation which it bears to recapitulation in ontogeny, one of these "academic problems of morphology" which were discussed with such avidity when both he and I were young, and which he relegates with such confident assurance to the limbo of obsolete things. Yet he writes of the older time: "Regardless of the obvious consideration that 'modification by descent' must be a chemical process, and that of the principles governing that chemistry, science had neither hint nor surmise nor even an empirical observation of its working."

One would almost suppose that Mr. Bateson was a bio-chemist. But how much chemistry is there in the analysis of Mendelian factors, or the identification of spots in chromosomes which represent particular genes? The suggestions of the nature of the "chemical process" have come from the physiologists and from those who, without ignoring the methods and discoveries of genetics, have not ceased to discuss evolution and adaptation. It is true that some geneticists have discussed the question whether factors for colour might be chemical compounds reacting on each other, but they have not explained how chemical compounds such as enzymes and chromogens could be contained in separate chromosomes and segregate from each other in the reduction divisions of gametes. I do not remember any case in which "modification by descent," that is the loss or gain of a unit character, has been shown by geneticists to be due to any chemical process. The latest results of the American investigators concerning the localisation of genes in the chromosomes, concerning which Mr. Bateson states that all his scepticism has been removed, are purely morphological.

All the progress that has been made in our knowledge of unit characters and of specific characters has tended to exhibit more and more clearly the difference between such characters and adaptational features. It is seldom that an adaptation is confined to a single species, and it is impossible to perceive any connexion between mutations or unit characters and the relation of adaptations to function and external conditions. One great event in the evolution of both animals and plants was the adaptation of the descendants of aquatic forms to terrestrial and atmospheric conditions. In the case of animals, we have, in the metamorphosis of Amphibia and the embryonic development of higher vertebrates the recapitulation of this transition from aquatic organs of respiration to atmospheric organs, not by conversion but by substitution. It is certain from this evidence that the change was perfectly gradual and continuous, and parallel to the gradual change of conditions and mode of life. Recapitulation in this case, however ancient a subject it may be, is an obvious fact, and nothing that the geneticists have discovered throws any light on it, or diminishes its importance. It is no use dismissing it as early Victorian. The question is, have the recent, much vaunted discoveries explained it, or have they anything to do with it? Variations in wings, eye colour, etc., of flies bred in milk-bottles are important in their own sphere, but they throw no light on the annual growth, denudation, death, and recrescence of the antlers of a stag, or on the remarkable relation between these processes and the hormones from the gonads. The origin of species is a very important problem, but it is not the whole, or the most important part, of evolution. The origin of adaptations is not the same problem as the origin of species, and the methods of modern genetics have very little bearing upon it. Mr. Bateson's address suggests that he has not yet realised the difference between the two problems, or paid serious attention to modern physiological knowledge bearing on functional adaptation. The phenomena of recapitulation, so closely associated with adaptation, imply wherever they occur a continuity in the evolutionary change of which the adaptation was the result, and these phenomena are quite incompatible with the discontinuity which is characteristic of non-adaptive variations, and which is the cardinal principle of Mendelians and mutationists.

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Evolutionary Faith and Modern Doubts.

No one can have read without interest Dr. Bateson's admirable address on evolution published in NATURE of April 29. While Dr. Bateson's reputation is justly high and his views necessarily command respect, it must be admitted that some of his arguments are very difficult to follow. When, for example, he says that "the conclusion that species are a product of a summation of variations, ignored the chief attribute of species, that the product of their crosses is frequently sterile in greater or less degree," I am frankly puzzled. The proposition is certainly not self-evident. If a sword and its scabbard are bent in different directions, it will happen sooner or later that the sword cannot be inserted, and the result will be the same whether the bending be effected by a single blow, or whether it be, in Dr. Bateson's words, "a product of a summation of variations." Is this illustration inapt? The sword and its scabbard are the homologous chromosomes. These presumably have to co-operate to produce the somatic cell of the hybrid, and their co-operation might be expected to require a certain resemblance, but for the production of sexual cells they must do more, they must conjugate; and for conjugation it is surely reasonable to suppose that a much more intimate resemblance would be needed.

We might, therefore, expect, on purely theoretical grounds, that as species and genera gradually diverged, it would be increasingly difficult to breed a hybrid between them; but that, even while a hybrid could still be produced, a fertile hybrid would be difficult or impossible, since the cells of the germ-track would fail to surmount the meiotic reduction stage, when the homologous chromosomes conjugate. This is exactly what happens: the cells go to pieces in the meiotic phase.

It would even seem that the argument is exactly contrary to Dr. Bateson's statement of it: it seems easier to imagine sterility arising from a gradual modification, spread over a length of time, and involving many chromosomes, than from the half-monstrous variations chiefly studied by Dr. Bateson and his school, variations which appear to affect only a few chromomeres, and those by loss alone.

Now I certainly cannot pretend to much or special knowledge, either in genetics or cytology. But I would ask Dr. Bateson in all humility whether there is any difficulty involved in this simple solution of his problem. Very likely there is, but he does not indicate it. C. R. CROWTHER.

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Transcription of Russian Names.

IN NATURE of May 20, p. 648, is published a letter from Maj.-Gen. Lord Gleichen, who raises objections to Prof. Brauner's suggestion (NATURE, April 29) that we should adopt the Czech transcriptions for the names of Russian men of science.

The argument that there are typographical difficulties is surely a very small one, since NATURE and other journals (*e.g.* that of the Chemical Society) already employ letters with diacritical marks in writing the names of Czech and other authors. Whilst diacritical marks are undesirable for place names on maps, the same need not apply to the names of persons.

The main points raised by Prof. Brauner in support of his suggestion, remain unchallenged, and in addition to these it may be mentioned that the Czech language is phonetic and Russian names can thus be accurately pronounced according to it.

Further, it may be confidently anticipated that the men of science and scientific institutions of the Czecho-Slovak republic will accomplish much in the way of scientific advancement in the future, and consequently will receive more adequate notice in British journals than has hitherto been the case (compare Prof. Brauner's own resumé of "Science in Bohemia" in NATURE, May 13).

Finally, many Russian authors now publish in Czech journals and consequently use the Czech transcriptions for their own names.

J. G. F. DRUCE.

May 24, 1922.

Immediate Solution of Dynamical Problems.

A DISCUSSION is submitted here in the manner called elementary, where the theorems of the gravitation of a sphere are proved for any portion of a spherical surface, such as a bowl, before proceeding to the result for a complete sphere (see letter by Prof. Andrew Gray in NATURE, May 20, p. 645).

Consider the potential (Fig. 1) at P, dU, and attrac-

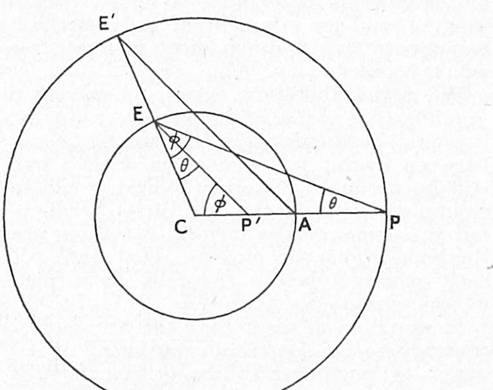

FIG. 1.

tion to the centre, dF, of a small element dS at E, of the surface of a sphere, centre C and radius $CA = c$, taken of superficial density σ, g/cm², with G the gravitation constant. Then

$\frac{dU}{G\sigma} = \frac{dS}{EP}$, with $EP = CE \cos\phi + CP \cos\theta$, so that, with $CP = r$, and P′ the inverse point to P in the sphere, $CP' = r' = \frac{c^2}{r}$, $\frac{dS}{EP} = \frac{dS}{EP^2}(CE \cos\phi + CP \cos\theta)$

$$= CE\frac{dS \cos\phi}{EP^2} + CP'\frac{dS \cos\theta}{EP'^2} \left(\text{because } \frac{CP}{CP'} = \frac{EP^2}{EP'^2}\right)$$

$$= CE\,d\omega + CP'd\omega' = c\,d\omega + r'd\omega' = c\,d\omega + \frac{c^2}{r}d\omega',$$

reckoning the solid angles $d\omega$, $d\omega'$ subtended by dS at P, P′ as positive when the aspect of the surface is the concave side.

Then by summation over any finite portion of the spherical surface,

$\frac{U}{G\sigma} = c\omega + r'\omega'$, not restricted to the spherical bowl result in Maxwell's "Electricity and Magnetism."

And for F, the radial component acting along PC of the attraction at P,

$$\frac{dF}{G\sigma} = \frac{dS \cos\theta}{EP^2} = \frac{CP'}{CP}\frac{dS \cos\theta}{EP'^2} = \frac{r'}{r}d\omega' = \frac{c^2}{r^2}d\omega', \quad \frac{F}{G\sigma} = \frac{c^2}{r^2}\omega'.$$

These two or three lines of geometry can thus replace some pages of analysis in Maxwell's "Electricity and Magnetism."

For a complete sphere, and P inside, $\omega = 4\pi$, $\omega' = 0$, $\frac{U}{G\sigma} = 4\pi c$, $F = 0$, and P outside, $\omega = 0$, $\omega' = 4\pi$, $\frac{U}{G\sigma} = 4\pi r' = \frac{4\pi c^2}{r}$, $\frac{F}{G\sigma} = \frac{4\pi c^2}{r^2}$; the well-known theorems for a complete spherical shell, and thence for a solid sphere, given first by Newton in the "Principia" (1, 41), and of pioneering interest in justifying his theory of gravitation for a body, like an apple, brought from the moon down to the surface of the earth.

A recent article by Florian Cajori, on Newton's discovery of Gravitation, in the *University of California Chronicle*, April 1922, is worth the attention of Prof. Andrew Gray, in its bearing on his own historical reflexions on the importance of the attraction of a sphere in Newton's theory of universal gravity.

The further theorem, that the mean potential over the sphere of any body M outside the sphere is equal to the potential of M at the centre, is obvious by transferring an element of M at P to the other end of the vector PE. Or if M is inside the sphere, the mean potential over the surface is M/c.

In hydrodynamical analogy, the flux across any surface fixed in an incompressible liquid is the equivalent of liquid supplied to the interior from outside, and so interpreting and justifying the theorem of Gauss, between the surface integral of normal force and the attracting body M, inside or outside.

In this way the precept of Poinsot can be followed, to examine the nature of things in themselves by direct vision, and not through a mist of equations and formulas.

G. GREENHILL.

1 Staple Inn, London, W.C.1, May 27.

Arabic Chemistry.

IN a manuscript in my possession of the "Rutbatu 'l-Ḥakīm" of Maslima ibn Muḥammad Abu 'l-Qāṣim al-Majrīṭī († 1004 A.D.) the author claims to have written the section on chemistry in the celebrated "Letters" of the Ikhwānu's-Ṣafā (Brethren of Purity), the well-known Encyclopædists of Islām in the tenth century A.D. I believe this fact to have been hitherto unknown, as it is not mentioned by Dieterici or Brockelmann nor by Shahrazūrī, all of whom give as the names of the authors of the "Letters" only the following five: Abū Sulaimān Muḥammad ibn Naṣr al-Bustī, Abu 'l-Ḥasan 'Alī ibn Hārūn az-Zinjānī, Abū Aḥmad an-Nahrajūrī, al-'Aufī and Zaid ibn Rifā'a.

Maslima al-Majrīṭī was an accomplished chemist, and his work the "Rutbatu 'l-Ḥakīm" was mentioned by Ibn Khaldūn in the "Prolegomena" to his history. Although much of the "Rutba" is, as Ibn Khaldūn observes, very enigmatical, yet there are certain passages in it of considerable historical interest to chemists. Two of these I give below.

1. "I took natural quivering mercury, free from impurity, and placed it in a glass vessel shaped like an egg. This I put inside another vessel like a cooking-pot and set the whole apparatus over an extremely gentle fire. The outer pot was then at such a temperature that I could bear my hand upon it. I heated the apparatus day and night for 40 days, after which I opened it. I found that the mercury (the original weight of which was ¼ lb.) had been completely converted into a red powder, soft to the touch, the weight remaining as it was originally."

2. [On the refinement of gold and silver.] "Silver alloyed with lead may be separated from the latter by placing it in a cupel made from bones (called the 'dog's head' or commonly the *kūraja*; it is a crucible made from burnt bones) and fusing it by means of a strong fire. The lead is removed and absorbed by the cupel and the fire makes manifest

the lighter portion of the alloy; the silver remains pure and free from base metal. Silver may be separated from copper in the cupel by continual addition of lead until it appears in a state of purity. . . . Gold may be purified from silver and copper in two ways. From copper alone it may be refined by the method used to purify silver from copper, namely, cupellation with addition of lead. If it is desired, sulphur may be added as well; this burns the copper and the gold remains pure. Gold may be refined from lead by the method used to refine silver from lead. The purification of gold from silver may be carried out in two ways, one by means of minerals and the other by means of salts. The former method is as follows: the gold alloyed with silver is beaten out into thin leaves and these are placed on a bed of a mixture of hæmatite and salt and covered with more of the same mixture followed by a layer of red clay. The whole is then heated in the oven known to men of science as the 'refining-furnace,' when the silver is absorbed by the earthy matter and the gold leaves are left pure, containing nothing but the most refined gold.

"This operation may also be carried out in a similar way by using alum and salt, or by means of baked clay. The clay is finely powdered and mixed with an equal amount of salt and the two well powdered again. The mixture is then spread in a layer on a layer of red clay. A gold leaf is then added, followed by another layer of the mixture of clay and salt, and so on until all the gold has been added. A covering layer of clay and sand is then placed on the top and the whole strongly heated, when the gold is purified and extracted from the silver. . . . This is the process known as *shahīra* [refinement] by the people of this art. Gold may also be separated from silver in the same way that it is separated from copper. The gold-silver alloy is mixed with a little copper and the mixture fused, with addition of red sulphur from time to time. The gold refines away from the silver and is left pure. The former method, however, is the more efficient.

"The silver which is removed from the gold in the process called *shahīra* may be recovered merely by the addition of mercury to the earthy residue. The mercury thickens and coagulates until it becomes like dough, and this is the sign [of the completion of the action]. When it has become like dough it is placed in a crucible over the fire and the mercury then volatilises away from the silver." E. J. HOLMYARD.

Clifton College, May 29, 1922.

The Notion of Asymmetry.

MODERN refinements in our ideas of atomic and molecular structure at once demand a more precise definition of what exactly is meant by molecular asymmetry. Whether this asymmetry be due to certain groupings around a particular atom, or to the structure of the molecule as a whole, such physical properties as optical activity or enantiomorphism must ultimately be shown to be definitely related to the electronic and nuclear arrangements in the molecule itself.

Langmuir has shown that substances with molecules possessing similar electronic environments closely resemble each other in many of their physical properties, and he calls this phenomenon isosterism, the substances themselves being denoted isosteres. In this brief discussion it will only be necessary to consider the application of this idea to the simplest case of stereoisomerism.

The molecule *Cabcd*, where *a*, *b*, *c*, *d*, are all different atoms or groups, is asymmetric. It exists in two stereoisomeric forms, one the mirror image of the other. The substance having this molecular structure may crystallise in two enantiomorphously related forms, and may rotate the plane of polarisation of light. Now let *d* be replaced by *c′*, where *c′* is an isostere of *c*. Such a molecule is now no longer asymmetric as regards the arrangement of its electrons, but is certainly asymmetric if we take into account the inner nuclei. If the rotation of the plane of polarisation of light is dependent entirely on electronic movements, such a substance may not be optically active, and it may not even crystallise in two forms. We have not sufficient data to decide this matter; but it is obvious that the application of this idea to the case of isotopic elements entering into combination might lead to some interesting investigations. We will only consider the substance $CH . SO_3H . Cl_{35} . Cl_{37}$, where Cl_{35} and Cl_{37} are the two principal isotopes of chlorine. This compound, like *Cabcc′*, is asymmetric as a whole, but so far as its electronic environment is concerned, the two stereo forms are identical.

Now this particular variety of di-chlor-methane-sulphonic acid must be formed to a certain extent in the ordinary preparation of the substance, and it would seem that its isolation could be effected, only if it *did* actually exist in two enantiomorphously related forms. From what has been said this seems rather unlikely, but still, an investigation in this direction would throw some light on the matter, one way or the other. THOMAS IREDALE.

University College, London.

The Evolution of Plumage.

MAY I be allowed to refer to some of the statements in the article on the Evolution of Plumage published in NATURE of May 20, p. 662.

(1) The writer (H. F. G.) states that in the case of ducks and penguins "the difference between their nestling coat and the final dress is enormous." In my paper on "The Nestling Feathers of the Mallard," I point out that the tail-quill protoptiles consist of a calamus, containing cones, a shaft and a distinct after-shaft, and especially that the barbules at the tip of the shaft in having hook-like cilia are more specialised than in some of the true metaptile feathers of the adult; hence it follows that feathers of the first nestling coat, instead of being simpler, may be more complex than true feathers of the adult coat.

(2) It is stated that in the emus the differences between the nestling feathers (protoptiles) and the feathers of the second and later generations "are reduced to a question of mere size." As the figures in my paper clearly show, the aftershaft of the feathers of the first generation is represented by a few simple barbs, whereas the aftershaft in the following generations is as long and as complex as the shaft.

(3) Owls and petrels are said to "have as thick and fluffy and long-lasting mesoptile coats as any penguin." In the case of the tawny owl the mesoptile coat is poorly developed and (in specimens I reared) shed soon after growth is completed—perhaps, like Pycraft, the writer of the article regards the feathers forming the first coat of true feathers in the tawny owl as mesoptiles; the feather figured in "A History of Birds" (p. 270) is not a mesoptile but a true (metaptile) feather. In a young petrel I received last autumn from Dr. Eagle Clarke, the mesoptile coat consists of simple feathers less than half an inch in length—in penguins the mesoptiles are complex and sometimes reach a length of four inches.

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(1) Surely the coats differ, almost beyond recognition in penguins; even in ducks, in which the first dress does not consist only of tail-quills.

(2) The figures [diagrams] show clearly that the all-important fact has been missed, namely, that the so-called aftershaft or byfeather consists not only of a few simple barbs but also of a distinct shaft.

(3) Perhaps it will save matters if we read: Some owls and some petrels have as thick and fluffy and long-lasting mesoptile coats as some penguins, relatively of course. For example, if some nestling feathers of the shearwater measure 24 + 26 = 50 mm. in length, this does not prevent large penguins from wearing still longer and longer-lasting coats; nor is it incompatible with some small petrels having mesoptiles (they vary much according to position) less than half an inch in length.

Perhaps some genius, not too much hampered by facts, may still discover a "law," or equation by which the palæontological dates of various groups of birds can be deduced from the relative emanations of their successive nestling coats. H. F. G.

The Atomic Weight of Mercury from Different Sources.

THE successful accomplishment of separating the isotopes of mercury (NATURE, 106, 144, 1920; *Phil. Mag.* 43, 31, 1922) suggested an investigation to determine the extent to which samples of mercury from different sources might show the same atomic weight, *i.e.* the same density, which is to be expected only if the various minerals contain the isotopes in the same ratio.

Mercury obtained from the following minerals was investigated:—

Mineral.	Geological Period.
1. Cinnabar from Almaden (Spain)	Silurian.
2. ,, ,, Phalz (Germany)	Permian.
3. ,, ,, Idria (Dalmatia)	Triassic.
4. ,, ,, California (U.S.A.)	Cretaceous.
5. ,, ,, Santafiora (Italy)	Eocene.
6. ,, ,, Ras-el-Mah (Tunis)	Upper Eocene.
7. ,, ,, Gölnicz (Hungary)	
8. Calomel ,, Terlingua (U.S.A.)	Lower Cretaceous.
9. Mercury oxychloride, Terlingua (U.S.A.)	Lower Cretaceous.
10. Cinnabar, synthetic, unknown origin	

After reduction with iron and repeated distillation of the metal *in vacuo* the densities were measured by the method described in the previous communication. We found no difference in density exceeding the possible experimental error, which amounted to 2–6 in a million, corresponding to 0·0004–0·0012 in the atomic weight. Considering the very different geological and geographical origin of the mercury samples investigated we can conclude, with great probability, that the isotopic composition of mercury of terrestrial origin is the same.

The following numbers are the density data (d_4^0) found in the literature:—

13·5959 (Regnault, 1807).
13·5958 (G. de Metz, 1892).
13·5956 (Vincenti and Omodei, 1888).
13·5953 (Volkmann, 1881).
13·5938 (Marek, 1883).
13·5937 (Thiesen and Scheel, 1898).
13·5886 (Biot and Arago, 1816).

The considerable differences exhibited by several of these numbers do not exclude the possibility that mixtures of different isotopic composition were measured. From the above-mentioned investigation, however, we are justified in assuming the differences as most likely due to experimental errors.

J. N. BRÖNSTED.
G. HEVESY.
Physico-Chemical Laboratory of the Polytechnic High School, Copenhagen, May 12, 1922.

The English Ph.D.

SOME time ago I had the privilege of listening to addresses by the heads of two prominent English colleges on the provisions for the English Ph.D. Quite frankly it was stated that this degree is intended to satisfy students from the Dominions and the United States. It is manifestly unfair to give an American, for example, as a result of his study a degree, like M.A., which is of little or no value in his own land.

Two fundamental mistakes, however, have been made which endanger the value of the English Ph.D. Perhaps this can be made clear by considering the matter from a purely practical aspect. The American undergoes the expense of his work for the Ph.D. primarily because it helps him to a better post than he would otherwise get. If his degree does not help him to earn his living it has no more than a sentimental value. When applying for his post, his degree is weighed by the faculty and other authorities. It is *their* opinion that determines the character of the university work for the Ph.D.

These people require evidence that the candidate has received what *they* consider to be the best training. In the first place, his degree must be from a place where his subject is well taught. For a post in geology the degree from a university where geology is represented by a distinguished professor is a valid claim, whereas one from a university with a less able geologist is of lower value. The English universities must recognise that the value of their Ph.D. depends on the distinction of their teachers and not on their antiquity or fame.

The general intellectual training of the man is a second factor. His degree must mean that he is imbued by the spirit of scientific research derived through contact with the leading investigators. This implies immediately that for the particular departments which the university decides to develop the Ph.D. instruction, it must have professors of the first rank. A general all-round training, at least in the man's particular subject, is also demanded. This implies that the student must spend his time at different universities. The man who has worked in physiology under Sherrington, Bayliss, Starling, and Langley is a better-trained man than one who has spent his whole three years with only one of them. The English system, however, seems to deny or discourage the principle of migration. Unless something like the German system of free migration is developed the English degree can never have a value equal to the old German one.

It is not necessary to discuss certain other regulations; they will lapse by their own failure. For example, one university has proposed that the student shall choose his problem of investigation at the beginning of his three years and devote himself mainly to following it under the guidance of the professor. Such a process would turn out a narrow-minded monk, and not the all-sided man of science of wide views that is demanded. Most of the regulations proposed by the universities are aimed at keeping out unfitted students—quite proper but minor considerations. In none of the discussions that I have heard has there been any conception of the more important matter of providing for the proper development of the scientific investigator with the gift of presenting his results to the world. Yet this is just what the American universities demand from candidates for vacant posts. What these provisions must be I will not attempt to indicate. They can be discovered only by careful inquiry into the causes of the success of some universities and the stagnation of others.

E. W. SCRIPTURE.

Identification of a Missing Element.

In two recent communications to the Paris Academy of Sciences (*Comptes rendus*, May 22), by M. A. Dauvillier and Prof. G. Urbain respectively, very definite conclusions have been reached as to the identity of celtium with the missing element of number 72 on the Moseley classification. This discovery is of special interest to British workers, since Moseley's last work dealt with this particular problem. Prof. Urbain adds a statement on the unpublished work of Moseley on the X-ray spectra of his preparations of the rare earths. In his paper M. Dauvillier announces the discovery of certain lines in the L X-ray spectrum of celtium which show that its atomic number is 72. An improved De Broglie photographic spectrometer was used, and the oxides of lutecium and ytterbium in a preparation of Urbain's were attached to the anti-cathode. The tube was run at a potential of 40 k.v., and nearly complete L-spectra of lutecium and ytterbium were obtained. In addition three lines of thulium were found and two feeble lines which were identified as the α_1 and β_2 radiations of celtium. These lines ($\alpha_1 = 1{\cdot}5618$ Å ; $\beta_2 = 1{\cdot}3194$ Å) fall in the correct places for the element of atomic number 72, between the corresponding lines of lutecium and ytterbium. The β_1 and γ_1 lines of celtium which might have been expected are coincident with the β'_2 and γ_3 lines of lutecium. Reasons are given why these lines of celtium cannot be due to any impurities, such as other rare earths.

The following is a translation of Prof. Urbain's paper in the *Comptes rendus*:

THE ATOMIC NUMBERS OF YTTERBIUM, LUTECIUM, AND CELTIUM.

"The results of M. Dauvillier's examination of my preparations containing celtium have a theoretical importance obvious to all who have followed recent scientific developments with regard to the chemical elements and their atomic structure.

"It is now unquestionable that the element of atomic number 72 is actually celtium. The atomic weight of celtium must therefore lie between 175 (lutecium) and 181·5 (tantalum). Characterised by two sets of spectral lines (arc and X-ray) and by the order of magnitude of its atomic weight, celtium has conclusively won its place among the chemical elements.

"Thus the problem of the constituent elements of Marignac's 'ytterbium' has been solved. The method of X-ray analysis is the most significant, and probably the crucial, test of a chemical element, and this method has confirmed the work I have done over a period of more than ten years on 'ytterbium,' using more difficult and probably less conclusive methods. Though I only succeeded in obtaining a partial separation, this was sufficient to permit the high-frequency spectra method to assign its atomic number to each of the constituents I discovered, namely, (neo-) ytterbium 70, lutecium 71, celtium 72.

"Now that these results are clear, I wish to outline a part of the history of these elements that has not yet become known to the scientific public. When I originally announced the discovery of celtium, Moseley's law of the atomic numbers was still unknown. After this law had been found it seemed evident that it should be possible to define the three elements of the ytterbium group by their X-ray spectra. Moseley himself put forward the hypothesis that celtium and the element with atomic number 72 were one and the same. On the other hand, Moseley, relying on the evidence of Auer von Welsbach, in his first lists of the elements had included two thuliums, while my experiments only permitted the existence of one.

"In order to settle this question, in June 1914 Ramsay and I visited Prof. Townsend's laboratory at Oxford, where Moseley was working. Our intention was to examine the different products of my separation of ytterbium by this young investigator's method, then unique.

"We found one thulium of atomic number 69, one ytterbium of atomic number 70, and one lutecium of atomic number 71. The spectra which Moseley obtained included only a few lines, and we could not find any corresponding to the element of atomic number 72. The first of these results was announced several years ago, but as the result of the researches of others. No claim of priority was possible, since Moseley himself was responsible for the publication of these results, and for this purpose had kept the necessary documents. But the war broke out before he had time to write his paper. He was among the first to enlist, and by great misfortune was killed at the Dardanelles.

"Sir Ernest Rutherford, who prepared the obituary notice of his pupil, wrote to me about these last researches of Moseley's, at which I had assisted. In the absence of precise data I thought I must forgo the publication of results that would rest on my memory alone.

"M. Dauvillier's discoveries complete the early results obtained at Oxford. They show that the negative result given by Moseley's method in the case of celtium was due only to the insensitiveness of the method, since the preparation examined by M. Dauvillier is the same as that used in Moseley's own X-ray tube."

Now that the missing element of number 72 has been identified, there remain only three vacant places of ordinal numbers—43, 61, 75—between hydrogen and bismuth in the Moseley classification of the elements. With the rapidly increasing perfection of technique of X-ray spectra and the use of powerful installations, it is to be anticipated that the missing elements should soon be identified if they exist in the earth. The law of the X-ray spectra, as found by Moseley, is an infallible guide in fixing the number of an element, even if present in only small proportion in the material under examination.

E. RUTHERFORD.

Recent Excavations at Stonehenge.[1]

By Col. WILLIAM HAWLEY, F.S.A.

The arrangement of the stones at Stonehenge includes on the outside a circle of sarsen stones, which were originally thirty in number and were capped with lintels, forming a continuous ring round the top. Inside this circle is another of smaller stones, originally forty-three in number, but without lintels and of a different rock from those of the outer circle.

Within the second circle of small stones were five

[1] Address to members of the Portsmouth Literary and Philosophical Society on the occasion of a visit to Stonehenge on May 6, 1922.

trilithons of large blocks of sarsen. Two only remain standing and one stone of the third. They have lintels, but the lintels were not continuous and merely formed a cap to the two upright stones.

The trilithons are not arranged in a circle but take the form of a crescent or horse-shoe, as also do a series of fifteen small stones within them, similar to the others in the second circle. The smaller stones (or foreign stones) are from metamorphic rocks and have been brought from a long distance, but how or when has not yet been determined. Dr. Thomas of the Geological Survey considers the source of two kinds to have been the Prescelly Mountains in Pembrokeshire, where he found identical specimens. He considered that their deposition here by glacial action to be contrary to sound geological reasoning, and that their assemblage here pointed to human selection and conveyance. One sort is a porphyritic diabase, another is a rhyolite, both of which are extremely hard. Another sort is an argyllite resembling hard slate, but being perishable, no standing stone remains, though many pieces are found in the soil below the surface. All these stones appear to have been brought in a rough state and in naturally long slabs, which were afterwards dressed.

The sarsens had less far to travel, and there can be little doubt that they were brought from the Marlborough Downs, where there are still many boulders of them strewn over the land.

These big blocks or boulders are composed of siliceous granules, and were formed in the Bagshot sand of the middle Eocene, and were left behind when the sand around them was denuded in a geological change.

Before being conveyed here they were roughly squared by cleavage to lighten them, and after arriving they were neatly dressed, partly by picking with pointed flint tools and partly by crushing and grinding with mauls made of a very hard quartzite.

After standing here for about 4000 years they have naturally become greatly weathered, some more than others, depending upon where softer patches in their substance occur, so that it is only on the durable parts that tooling marks can be seen, but these are very clear where the surface has not been exposed, where the stones are protected below ground, and where the lintels fit upon the uprights.

For many years several of the stones were leaning dangerously and had to be propped, notably the four on the north-east and two on the east, all bearing lintels. H.M. Office of Works has had these stones set upright, and their bases are now firmly fixed in beds of concrete.

In this operation it was necessary to take down the lintels, and we were much impressed by the elaborate care that had been bestowed upon fitting them to the tops of the stones. Every lintel has two cup-shaped holes, which fit upon tenons projecting from the upright stones, so that each lintel has two holes and each upright has two tenons (except the trilithons which only require one tenon on each upright).

The fitting of the lintels to the tops of the stones had been done with such accuracy as to leave little doubt that they had been worked in unison and the lintel frequently tried on until a perfect fit had been accomplished. The same care was observable in the fitting of the ends of the lintels, as each one has a projection which fits into a recess in the next following it, locking them all together, and all this must have been done when the stones were upright and to ensure evenness of the tops all the way round.

These stones were irregular in their depth below the surface, the longest having 8 feet and the shortest 4 feet 6 inches below ground. The bases end in a blunt point, to facilitate movement when getting them into position. Most of them seem to have been brought to their places down an inclined plane cut in the solid chalk, but two cases were met with where they had been put in vertically. The pieces broken off the bases when pointing them were used for propping them whilst adjusting their position and before the soil was returned to the hole around the stone. A great many other pieces of stone had to be used, and these had to be sought at places a few miles from Stonehenge, as there is no stone in this neighbourhood. Wooden posts were used for a similar purpose, their holes being found below the stones and sunk about two feet in the chalk. The acquired stone was of two sorts, a glauconite and a ragstone, the former from Hurdcote near Wilton and the latter from Chilmark, a few miles farther west. The same quarries appear to have been used ever since, as similar stone is frequently met with in the British villages of the Roman Period, and we found that they had supplied all the stone for the building of Old Sarum. In this case a freestone had been used and not the rough slabs found here. The freestone occurs at a lower level, and is extensively quarried at the present day.

Finds of interesting objects have been remarkably few; indeed nothing of any special interest. The things found consist chiefly of rough flints used for dressing the stone and stone mauls, or hammer stones, of various sizes up to 43 lbs. in weight. Immense quantities of chips were knocked off by the masons. Those of sarsen occur at all depths, but those of foreign stone not lower than 30 inches, as they were put in last of all, and the building was probably a long, continuous work. The rubble below the surface, besides containing chips, yielded a few pieces of Bronze Age pottery, very small and foot-worn. The firm rubble had arrested the descent of these and also of small pieces of Roman Period pottery, and very occasionally a coin of that time. These were mixed with other things that had reached the rubble at every succeeding age down to the present time.

It is remarkable that the great number of people employed upon the construction of the place have left nothing behind them, for life in the Stone Age was not incompatible with a fairly high state of culture, as has been noticed in many instances. There was pottery of excellent design at the Temple of Tel Harkien at Malta, of Neolithic times, some of it being beautifully inlaid.

The use of this place has not yet been determined. Among ancient races religious and secular matters were intimately mixed, but this place could not have been for secular use, as apparently it was not inhabited. There are perhaps as many theories about Stonehenge as the stones which compose it, yet nothing is known with certainty about the nature of the place. It is trusted, however, that when the present research is finished some definite conclusion may be arrived at.

The place has been surrounded by a circular earthwork and outer ditch. Also, within the earthwork there are round patches of chalk. These have been placed there to mark the sites of holes which were discovered two years ago. We have named them Aubrey holes after an investigator of that name who, in 1666, hinted at their possible existence, but did not find them. Only about half the number has been opened, but we have ascertained that there are fifty-six. They are evenly spaced at 16 feet apart, and there can be little doubt that they once held stones forming a continuous circle, older than the existing monument. The old circle stones would have been rough, undressed ones, and perhaps of about the date of Avebury. When the present monument was built it is possible that the rough stones were taken out and dressed and erected as the smaller stones now visible, as it is not likely they would have been wasted, and, moreover, their number corresponds nearly with that of the holes.

The empty holes appear to have been used for human interments, as nearly all of them contained cremated bones. Only a portion of the cremated remains of a body are found in each hole and in one instance only fourteen pieces of charred bone. The actual cremations must have been carried out elsewhere and the remains brought here for interment, for up to the present time no sign of a large fire has been met with; and the burning of only one body would require several tons of wood to calcine it thoroughly, and the quantity of black wood ashes remaining, being indestructible, would have been noticed. These interments occurred in Neolithic times, as chips were found amongst the debris in the holes, and in one instance an implement maker had thrown all his discarded chips into a hole.

Lately I have been excavating the ditch outside the earthwork. It was probably the first work done here, and from it I trust to get a continuous linking up of periods from the earliest to the latest. So far this work has not been very profitable, but has given a good result in showing that a very long time must have elapsed between making the ditch and rampart and the building of Stonehenge. It seems to have fallen into neglect, and was nearly silted up when Stonehenge was built. This is conclusively shown by finding the masons' chips only 14 or 15 inches below the surface in the rubble covering the silt, where they cease abruptly, the silt containing no trace of anything relating to Stonehenge. It is devoid of any objects beyond occasional small fragments of animal bone, but when the bottom is reached at 4½ to 5½ feet below the surface, flint chips discarded by implement makers are found in great quantities, but rarely an actual implement. Many staghorn picks used in the excavation of the ditch are met with, and the upper parts of antlers cut off and thrown away when the picks were made.

This season I am again excavating the ditch, and this time on the north-east, to find out if it was a continuous circle or whether the avenue was made at that time or later, when Stonehenge was built, for I am inclined to think that there were two distinct periods here—an early one, when the circle of stones stood round the rampart, and a later one when this Stonehenge was built, with a considerable interval between them.

The Sense of Smell in Birds: a Debated Question.

ORGANS of smell are present in birds as a class and are well developed in many species, but much doubt attaches to the nature and extent of their usefulness. The South American vultures and the petrels are noteworthy for the size of their olfactory chambers, and the Apteryx possesses a complicated nasal labyrinth and is peculiar in having its nostrils at the extreme tip of the beak. Yet even in cases like these the practical demonstration of a sense of smell is beset with difficulties, and the existing evidence is conflicting and largely inconclusive. It seems difficult, of course, to believe that the apparatus serves no purpose, especially where it is highly developed or is specialised along particular lines, but apart from the unsatisfactory quality of *a priori* arguments the alternative must be borne in mind that the organs may have some other function than a sense of smell of the kind with which we are subjectively familiar.

The sense of smell is notoriously acute in the majority of mammals. Although they are generally also well endowed with sight and hearing, it is by smell that they chiefly find their food and by smell that they receive the first warning of the proximity of enemies: the importance of approaching four-footed game up-wind is a commonplace. In birds the case is obviously very different, for with them vision must certainly be given pride of place. Hearing, too, is very well developed in birds, and there is also often a delicate sense of touch—witness the bill of the snipe—and possibly some power of discriminating food by taste. It may be argued that a sense of smell would be less useful to birds than to mammals: the great distances from which some birds detect their prey seem practically prohibitive for any sense but vision, and the spaces of the upper air must form a much less favourable medium for scent than the ground winds on which mammals so greatly rely.

Like so many other problems of natural history, this question attracted the attention of Charles Darwin, and in "A Naturalist's Voyage Round the World" we read of the experiment which he made in a garden in Chile where twenty or thirty captured condors were tethered in a long row at the bottom of a wall. "Having folded up a piece of meat in white paper," he says, "I walked backwards and forwards, carrying it in my hand at a distance of about three yards from them, but no notice whatever was taken. I then threw it on the ground, within one yard of an old male bird; he looked at it for a moment with attention, but then regarded it no more. With a stick I pushed it closer and closer, until at last he touched it with his beak; the paper was instantly torn off with fury; at the same moment, every bird in the long row began struggling and flapping its wings. Under the same circumstances it would have been quite impossible to have deceived a dog." In the same place Darwin refers to the well-authenticated experiments of a Mr. Bachmann with the American turkey-buzzard, another carrion-eating vulture and one in which highly developed olfactory nerves had been demonstrated by Owen. Portions of highly offensive offal were wrapped in thin canvas: the birds seemed unable to detect the food even when eating pieces of meat which were in some cases strewn on the outside of the package, but as soon as a small rent was made for them in the canvas the prize was at once discovered.

Both before and since Darwin's day the question of the absence or presence of acute smelling powers in birds has been much discussed, and the negative view has been maintained by many ornithologists of repute. To this question Mr. J. H. Gurney now makes a welcome and interesting contribution in a recent paper "On the Sense of Smell Possessed by Birds" (*Ibis*, 1922, Eleventh Series, iv, 225). After recounting the history of the discussion and making reference to the anatomical facts and experimental findings, he deals at length with the observational evidence in favour of the existence of an acute sense of smell in certain species. Among these the rook and some woodpeckers are cited on account of the accuracy with which they seem able to locate hidden grubs, below the ground in one case and beneath the tree-bark in the other. Various petrels are also mentioned, some of these being credited by good observers with the power, for instance, of detecting offal thrown overboard by fishing boats even in thick mist. Geese and ducks, too, have very frequently been thought to possess powers of smell, and in the Norfolk duck-decoys the watching decoyman customarily burns peat or the like to prevent the birds scenting him down-wind. Other birds, notably the great bustard, commonly forsake their nests if their eggs have been handled. The most striking case, however, is that of the vultures of different kinds which are familiar in many parts of the world. It is indeed difficult to explain on any other theory than that of scent how these birds of ill-omen should know when a death has occurred in a house, congregating on the roof as if in the hope of gaining access to the corpse which they cannot possibly have seen: the same faculty was traditional in this country as regards the raven, when that species was commoner than it is now. Against all this, however, there is a mass of testimony from naturalists and sportsmen that birds show little or no power of detecting the presence of an enemy, even if approaching down-wind, until either sight or hearing comes into play. The success with which bird photographers can conceal themselves close to birds' nests, for instance, is in marked contrast to the difficulty experienced in studying wild mammals. In the case of vultures, in particular, there is also the evidence of the experiments already quoted, and the experience of sportsmen in India that killed game is safe from these birds if left covered from view.

In view of the weakness of the evidence obtainable by direct observation, due to the difficulty of eliminating the possible action of the other senses under ordinary conditions, one would naturally look with hope to experimental methods. These, however, have not been altogether neglected, and the results have been disappointingly inconclusive. Bachmann's experiment, already quoted from Darwin, seems to be one of the best on record. Another essay was Dr. Alexander Hill's experiment (NATURE, February 2, 1905) with domestic Turkeys, to which he offered alternative dishes of the same food, one untainted and the other containing some such substance as asafœtida, essence of anise, or oil of lavender. The results were very unsatisfactory, the birds appearing to be indifferent not only to the smell but also to the taste of the noxious substances. In America, Dr. R. M. Strong has tried the effect of placing hidden food close to doves confined in boxes which could be regulated to admit or to exclude odours. Here again the results were negative, no notice being taken of the food by any of the birds. To these may perhaps be added the experiment carried out by Prof. Watson and Dr. Lashley on the noddy and sooty terns of the Tortugas Islands off the coast of Florida. These investigators were studying the homing faculties of breeding terns, and in some cases they tried the effect of sealing up the birds' nasal chambers with wax: here again no difference in behaviour was observable. This last experiment is of special interest because it had for its object the testing of the theory that the olfactory apparatus may function not as an organ of smell but as a mechanism for detecting the temperature or humidity of the wind and thus as an aid to directional guidance during prolonged flight.

There is, then, a well-developed olfactory apparatus in birds which one is reluctant to consider altogether ineffective, and there are instances of behaviour which are difficult to explain except on the supposition that an acute sense of smell exists in the species concerned. On the other hand, there is a greater mass of evidence of behaviour suggesting that the sense is not developed to any important extent, and the results of experiments—so far as they can be considered satisfactory at all—point in the same direction. It accordingly remains difficult to arrive at any definite judgment on the question, and scepticism as to the existence of any very efficient sense of smell in birds is probably still warranted. As Mr. Gurney says, the *onus probandi* rests with the upholders of the scenting theory.

The Hull Meeting of the British Association.

IT is ninety-one years since the British Association for the Advancement of Science was founded, in Yorkshire, and it is sixty-nine years since the Association paid its single visit to Kingston-on-Hull. One prominent Hull citizen, the head of an important industry, who was present at the Hull meeting *as a member* is still living, but it is not anticipated that many others will remember the previous Hull meeting.

By the appointment of a strong executive committee and numerous sub-committees the arrangements for the Hull meeting are well in hand, and it is hoped that the attendance at Hull may exceed that at Edinburgh; everything possible is being done to attain that object.

Situated on the broad estuary of the Humber, at the junction of the river Hull, King Edward I., so long ago as 1299, saw the geographical advantages of the town, and acquired the site from the monks of Meaux, from which date it became Kingston-on-Hull, and he gave a charter granting a fair (which is still held) and other privileges, which are yet preserved. Formerly a walled town, it played an important part in the Civil War in 1642, and still retains a number of buildings prior to that date which exhibit architectural features of interest.

To-day the city has nearly 300,000 inhabitants, many of whom obtain their livelihood from the fishing, shipping, and ship-building industries, and from the great works and mills connected with the production of oil, cattle food, flour, cement, black lead and blue, tar, paints, etc. There are also important fruit and wool markets, and many acres of timber yards. Enormous docks extending for miles accommodate shipping from all parts of the world, and in connexion with them are great warehouses and important railway and canal communications. In recent years, the King George Dock, one of the most up-to-date in the country, has been opened, a fine river-side quay has been erected, and there are elaborate appliances for the prompt handling of coal and for the storage of mineral oil. All this means that there is much of interest in the city to scientific workers.

Situated at the foot of the Yorkshire Wolds, Hull enjoys the position of being surrounded by a thinly populated area and has no other large town within many miles. It has special rail facilities for access to Scarborough, Filey, Flamborough, and other charming parts of the Yorkshire coastline, second to none in the country for variety of scenery and grandeur of cliff. Similarly the fine cathedrals and churches at York, Beverley, Selby, Patrington, Bridlington, Howden, and Hedon, well known throughout the country for their architectural charms, can easily be approached.

The plain of Holderness, with its cliffs of glacial sands and clays, provide problems for the glacial geologists, and rarely does it happen that so extensive and varied sections are available for study. The chalk wolds form a prominent feature, and quite apart from their geological and artistic attractions, were formerly thickly peopled by Briton, Roman, Saxon, and Dane, whose earthworks, burial mounds, and other remains still form attractive features in the landscape. During half a century the late J. R. Mortimer excavated most of these sites, and gathered together the contents of more than 350 burial mounds in his museum at Driffield, which has since been purchased for the Hull Corporation.

The Humber area itself has many problems of interest to the engineer, botanist, geologist, zoologist, and antiquary; while Spurn Point, with its questions of the sites of the lost towns of the Humber and of the coast, is of more than ordinary general interest.

During the Hull meeting special trains and other facilities will enable members to visit the various and numerous attractions in the East Riding and in North Lincolnshire; and already arrangements have been made for visits to be paid to places likely to interest the members.

In Hull itself, besides the fine old buildings already referred to, there is the Holy Trinity Church, one of the largest parish churches in the country, and certainly one of the oldest brick buildings still extant. In recent years the town has been entirely re-planned and largely rebuilt, fine wide thoroughfares having been cut through slum property, and these are lined with magnificent shops and public buildings. Of special interest to the visitors will be the old Trinity House and its Museum in Trinity House Lane; the birthplace of William Wilberforce, an Elizabethan mansion in High Street, now Hull's Historical Museum; the Museum of Natural History and Archæology at the Royal Institution, Albion Street; the Museum of Fisheries and Shipping at the Pickering Park; the Art Gallery in the City Hall; the Central Public Library in Albion Street, the Art School, and Technical Schools, and the old Grammar School (dated 1584) in the market place, all of which will be available to the visitors.

The city, being built on alluvium, is remarkably flat; its many miles of roads are excellently paved with wood blocks or asphalt, which, with the wide streets and fine buildings, give an appearance of cleanliness which is the envy of many larger cities. Hull is the only city in the country with its own telephones; its water supply is of the best, being drawn from chalk; and through the generosity of various benefactors and municipal enterprise, the city is well provided with public parks.

The various large engineering and manufacturing firms in Hull and district are taking keen interest in the meeting, and invitations to visit their works have been received. The Yorkshire Literary and Philosophical Society, at York, is issuing invitations for the members to visit its museum and grounds, and will provide afternoon tea, while the Lord Mayor of York will give a special welcome and has invited the members to visit the Guildhall and Mansion House. Hearty invitations have also been received from the Mayors of Scarborough, Bridlington, and Beverley to visit their respective towns, and each is doing his best to enable members to view the town's attractions, and refreshments will, in each case, be provided. The North Eastern Railway Company is taking exceptional pains to provide special trains, reduced railway fares, and late train facilities, in order to give the members every possible opportunity of visiting different places in East Yorkshire.

The local programme is a particularly attractive one, and the various lectures and addresses have an important bearing upon the district. For his presidential address Sir Charles Sherrington will take as his subject "Some Aspects of Animal Mechanism."

During the week the addresses of the sectional presidents will be delivered as under: "The Theory of Numbers," Prof. G. H. Hardy; "Research Problems in the Sugar Group," Principal J. C. Irvine; "The Physical Geography of the Coal Swamps," Prof. P. F. Kendall; "The Progression of Life in the Sea," Dr. E. J. Allen; "Human Geography: First Principles and Some Applications," Dr. Marion Newbigin; "Equal Pay to Men and Women for Equal Work," Prof. F. Y. Edgeworth; "Railway Problems in Australia," Prof. T. Hudson Beare; "The Study of Man," Mr. H. J. E. Peake; "The Efficiency of Man and the Factors which Influence," Prof. E. P. Cathcart; "The Transport of Organic Substances in Plants," Prof. H. H. Dixon; "The Proper Position of the Landowner in Relation to the Agricultural Industry," Right Hon. Lord Bledisloe; "Educational and School Science," Sir Richard A. Gregory. The lamented death of Dr. W. H. R. Rivers deprives the psychology section of its president-designate. He had chosen as the subject of his address "The Herd-instinct and Human Society."

Among the subjects of joint discussions are: "Economic Periodicity," "The Origin of Magnetism," "Psychoanalysis and the School," "Mental Characters and Race," "The Present Position of Darwinism," "Vitamins," "The Possibility of increasing the Food Supply of Great Britain," and "Reformed Mathematical Teaching."

There will also be evening discourses on "The Atoms of Matter," by Dr. F. W. Aston, and "Fishing: Old Ways and New," by Prof. W. Garstang.

Special efforts are being made by the local secretaries at the Guildhall, Hull, to secure a large list of members, as by so doing it is hoped substantial grants may be made to the Association towards the advancement of science in its various ramifications. T. S.

Obituary.

Dr. W. H. R. Rivers, F.R.S.

Dr. William Hale Rivers Rivers, whose death occurred on June 4 at the age of fifty-eight years, came to Cambridge, at the invitation of Sir Michael Foster, in October 1893, to lecture on the psychology of the senses, and was made University lecturer in physiological and experimental psychology in December 1897; these two subjects were separated in 1907, when Rivers was made lecturer in the physiology of the senses. By this time he had established the Cambridge School of Experimental Psychology, which has produced many distinguished psychologists.

In 1898 Rivers joined the Cambridge Anthropological Expedition to Torres Straits and had charge of the psychological work, in which he was ably helped by his pupils, C. S. Myers and William McDougall. This was the first occasion on which trained psychologists with adequate equipment had attempted to investigate the psychology of natives in the field, and valuable results were obtained. While studying the psychology of the Torres Straits Islanders, Rivers began to collect genealogies in order to ascertain how far aptitudes or disaptitudes ran in families. He very soon found that the genealogies revealed a number of valuable data with regard to vital statistics, such as the number of births and deaths in a generation, the proportion of the sexes, the effects of fresh strains coming into a family, and the like. This method of research enabled him to record kinship terms with accuracy, and a consideration of them led to a study of social organisation. He also found that certain social duties and privileges were confined to certain specific relationships. Thus step by step he was led to realise the prime importance of social grouping for an understanding of social structure and function, and he found that the genealogical method was best fitted to supply the necessary data. On joining the Expedition, Rivers went out with the sole object of studying comparative psychology; he came back a keen ethnologist, having in the meantime forged a new instrument of research.

Four years later, in 1902, he went to south India to investigate the Todas, and in his important monograph ("The Todas," 1906) on that small but most interesting people, he proved once more the value of the genealogical method. His researches demonstrated how a trained mind, sympathetic manner, and scientific method can accomplish a great deal of first-class work in a relatively short time.

His first expedition to Melanesia was made in 1908, when he devoted most of his time to the Solomon Islanders. The practical result of his work there was the publication in 1914 of his monumental "History of Melanesian Society." The Melanesians were usually regarded as primitive folk of low culture, but Rivers demonstrated the existence of at least four layers of culture, due to as many migrations into that area. He dissected out, as it were, the main constituents of each layer, and showed that certain beliefs, rites, customs, and objects were found to be linked together in an organic whole in each layer or complex. He also discussed acutely the probable effects of one culture upon another, and showed that certain conditions which had usually been considered as due to social evolution were better regarded as a case of social adjustment between a pre-existing and an immigrant custom. The method formulated by Rivers is one of prime importance and is capable of indefinite extension to other peoples.

As an example of the continual growth of the mind of Rivers and his intellectual honesty, it is interesting to note that in his presidential address to Section H of the British Association in 1911, and in his "History of Melanesian Society" (1914), he points out the change that had taken place in his standpoint. The greater part of the book had been written as an evolutionist, and, in common with other English ethnologists, he believed that similarities of custom and belief are the results of the uniform reaction of the human mind to similar conditions. A further consideration of the facts and problems with which he was then occupied led him to the view that these similarities are the result of diffusion from a common source by means of migration—a view which certain older British ethnologists had held, though it was temporarily neglected. This change of standpoint prepared Rivers for an enthusiastic acceptance of the main principles enunciated by Prof. G. Elliot Smith in his "Migrations of Early Culture" (1915), and ever after Rivers was a keen supporter of cultural migrations.

Throughout this time Rivers continued teaching in the School of Psychology, and maintained his interest in that subject. He also made researches on the influence of alcohol and other drugs on fatigue, and on cutaneous sensibility in collaboration with Dr. Henry Head.

During the period of the war, Rivers was made temporary captain in the R.A.M.C., and naturally occupied himself with psychopathology. He was appointed Medical Officer to the Military Hospital, Maghull, later to the Craiglockhart War Hospital, and finally was psychologist at the Central Hospital R.A.F.

His wide knowledge, not only of psychology but of human nature, gained by investigation of various types of natives, his interest in the minds of all with whom he came in contact, together with a broad sympathy and charming manner, rendered him peculiarly fitted for this delicate and highly important work. His success was very great, and he kept in touch with as many of his old patients as was possible, and as their letters prove, they regarded him with intense gratitude and affection. The experience thus gained enabled him to produce his later important works, such as "Instinct and the Unconscious," and his lectures and papers on dreams. He accepted many of Freud's conclusions, but carried them to a very different issue in the light of his own observations during his military service.

From the foregoing it is evident that the mind and sympathies of Rivers were not only continually becoming more intensive, but were simultaneously broadening; he regarded all human conditions as the appropriate study of psychology and ethnology. This is illustrated by his last phase, when friends in London, knowing his interest in labour conditions, invited him to stand as Labour candidate for Parliament for the University of London. He agreed to do so, as he felt that his special knowledge might be of use under the present critical conditions; it was not political influence that attracted him, but merely a desire to give his best to his fellow-men; to quote his own words: "To one whose life has been passed in scientific research and education the prospect of entering practical politics can be no light matter. But the times are so ominous, the outlook, both for our own country and the world, so black, that, if others think that I can be of service in political life, I cannot refuse."

It seems almost superfluous to point out what a loss the death of Dr. Rivers is to psychology and ethnology. His keen critical mind and his insistence on scientific method were of inestimable importance to these young sciences; he, more than any one else, was establishing ethnology as a scientific discipline. It is impossible to indicate what his death means to his many friends.

A. C. HADDON.

DR. WILLIAM CARRUTHERS, F.R.S.

DR. WILLIAM CARRUTHERS, who died on June 2 at the age of ninety-two years, was a familiar figure in the botanical world in the latter half of the last century. He was born at Moffat, Dumfries, in 1830, and educated at Edinburgh with the view of entering the Presbyterian ministry, but decided in favour of a scientific career. In 1859 he was appointed assistant in the Department of Botany of the British Museum to J. J. Bennett, who had recently succeeded Robert Brown as Keeper of the department. In 1871 Dr. Carruthers followed Bennett in the Keepership, which he held until his retirement in 1895. His tenure of office was marked by a great development of the department. The removal of the natural history collections to the new museum in the Cromwell Road in 1881 afforded a unique opportunity for improvement and expansion; and the arrangement and equipment of the suite of galleries assigned to botany, including the great herbarium and the excellent botanical library, approached through a fine exhibition gallery, are a lasting memorial of Dr. Carruthers's knowledge and skill. The development of the Cryptogamic Herbarium, with the help of Mr. George Murray, and of the special British Herbarium, based on the collection of his chief assistant, Dr. Henry Trimen, the arrangement of the valuable collection of original botanical drawings and manuscripts, the planning of the exhibition galleries, and the initiation of a series of botanical monographs, such as Crombie's Enumeration of the British Lichens and Lister's Monograph of the Mycelozoa, may be recalled as incidents of his tenure. A fuller appreciation of these activities by another colleague, Mr. James Britten, will be found in the *Journal of Botany*, 1895.

Those who worked under Dr. Carruthers cherish pleasant recollections of the association. Always kind and sympathetic, he allowed his assistants full scope in the various sections of which they were placed in charge, and himself set an example of courtesy and helpfulness to visiting students and the casual inquirer. He had a strong sense of justice, and was prepared to uphold his views. Sundry hatchets, now happily buried, could testify to his capacity as a fighter.

Elected Fellow of the Linnean Society in 1861 (he has missed by one point the position of father of the Society), for more than forty years Dr. Carruthers took an active interest in its affairs. From 1886 to 1890 he was president, and his term of service included the centenary celebration in 1888. He took a great personal interest in Linnæus, and older fellows will remember the meticulous care with which he worked up the subject of the portraits of Linnæus for a presidential address. His doctorate, Ph.D. of Upsala University, was conferred on the occasion of the bicentenary celebration of the birth of Linnæus in 1907, at which Dr. Carruthers represented the Society. In 1871 he was elected a Fellow of the Royal Society, and in the same year was appointed consulting botanist to the Royal Agricultural Society, a position which he held until 1910. His yearly reports and other communications to this Society form a valuable contribution to the economic side of botany dealing with diseases of crops, pasture grasses, the purity and germinating capacity of seed, and the like. In this connection he established in his own house a seed-testing laboratory. Dr. Carruthers was also a Fellow of the Geological and Royal Microscopical Societies, and served as president of the latter; he was also president of the Biological Section of the British Association (1886) and of the Geologists' Association (1876).

The chief contributions made by Dr. Carruthers to pure science were in palæobotany, more especially the study of the carboniferous flora. The most productive period of these researches was in the 'sixties and 'seventies, and his monograph on the fossil Cycadean Stems of the Secondary Rocks of Britain (published in the Transactions of the Linnean Society, 1870), from which the genera Williamsonia and Bennettites date, remains a classic. Though his scientific work began almost coincidently with the appearance of the "Origin of Species," he was not attracted by the Darwinian theory, which he considered was not supported by the testimony of palæobotany. Dr. Carruthers was also keenly interested in Puritan history and biography, for the pursuit of which study his retirement from the Museum in 1895 gave increased opportunity. His younger son, John Bennett Carruthers, who predeceased him, held important botanical posts in several parts of the Empire, Ceylon, the Federated Malay States, and Trinidad. A. B. R.

ADOLPHUS COLLENETTE.

MR. ADOLPHUS COLLENETTE, who died in Guernsey on May 7, in his eighty-first year, was an active worker in local climatology and physical geography, as well as an interesting personality, full of enthusiasm for the scientific point of view. His frequent expositions of scientific discoveries and theories in addresses, papers, and articles in the local society's transactions and the local press made him a well-known figure, and undoubtedly helped to arouse a good deal of scientific interest in an island which gives special opportunities for study. He was one of the moving spirits in what has now become the Société Guernesiaise, and his very active temperament made him one of its best-known guides in the long series of excursions which it has organised to teach its members the features of the Channel Islands. It is noteworthy that the research interest was well to the fore in this work. For many years Mr. Collenette kept detailed meteorological records in succession to those of the late Dr. Hoskins, so that the book he was writing at his death on the climate of Guernsey would have been based on observations registered continuously for nearly eighty years.

Mr. Collenette read a great deal of contemporary scientific literature and studied local details in the light of this reading. His was an attitude of courageous adventure; he made frequent suggestions criticising or modifying the theories of recognised authorities, sometimes with serious evidence to back him, always, at any rate, with the stimulation of discussion and further observation as a result of his work. Like Mr. Joseph Sinel of Jersey, he concerned himself especially with the relations of land and sea, and did a good deal towards the tracing of the raised beaches and some submerged beaches around Guernsey. One set is at maximum elevations between 23 and 30 feet, another varies between 46 and 65 feet; higher elevations range up to 75 feet. Mr. Collenette tried to identify platforms of marine denudation in connection with these beaches, and claimed to show that there were former sea-levels at practically all elevations from ordnance datum up to 300 ft.

While both Mr. Sinel and Mr. Collenette broadly accepted Mr. Clement Reid's view that the coast-level has been relatively stable during the past 2000 years, they nevertheless think that, in detail, there has been slow submergence around the Channel Islands within that period, and the evidence is by no means negligible. It was characteristic of Mr. Collenette that he upheld the view that Guernsey once had an ice-cap, and he claimed to show that Guernsey is rich in primitive implements, rostro-carinates and the like, including many made of crystalline rock. On this last point judgment must be left to the future.

Mr. Collenette gave attention to problems of local fruit-growing and contributed to research on tomato diseases. He was also honorary curator of the museum at the Guille-Allès Library and shared in its pioneer efforts for scientific education. It is greatly to be hoped that in the reconstruction which must follow his death, an effort will be made to combine all the local antiquities at the now public Lukis Museum, which is so important scientifically, and thus to permit the further development of the biological and geological collections at the older institution.

THE death on April 25 of Dr. Jenö Holzwarth, professor of radiology at the University of Budapest, is announced in the issue of the *Lancet* for May 20. Prof. Holzwarth studied at one time under Prof. Röntgen and afterwards acted as surgical radiologist in the clinic of Prof. Dollinger. During the earlier years, when insufficient protective appliances were in use, he suffered injuries which later developed into malignant disease. His chief contributions to the subject of radiology were on the therapeutic side, and his main papers are to be found in the *Orvosi Letil*, Budapest, during the years 1907–12. This publication appears to have ceased since the war.

WE much regret to record the death, on June 10, of Prof. William Gowland, F.R.S., emeritus professor of metallurgy, Royal School of Mines, in his eightieth year; also of M. Ernest Solvay, the distinguished industrial chemist and founder of the Solvay Institute of Chemistry, at the age of eighty-four years.

THE *Chemiker Zeitung* of May 27 announces the death of Prof. C. V. Zanetti, Director of the Institute of Pharmaceutical Chemistry and Toxicology in the University of Parma.

Current Topics and Events.

THE second conversazione of the Royal Society this year will be held in the rooms of the Society at Burlington House on Tuesday, June 20.

AT the annual meeting of the American Academy of Arts and Sciences, Prof. A. S. Eddington and Sir T. Clifford Allbutt were elected honorary foreign members.

THE annual conversazione of the Institution of Electrical Engineers will be held at the Natural History Museum, South Kensington, on the evening of Thursday, June 29.

THE unveiling and dedication of the War Memorial in memory of the members of the Institution of Electrical Engineers who fell in the Great War will take place at the Institution building on Wednesday, June 28, at 4.30 P.M. The memorial will be dedicated by the Rt. Rev. Bishop Ryle, Dean of Westminster, and unveiled by Air Chief Marshal Sir H. M. Trenchard, Bart.

MR. GEORGE F. BAKER, chairman of the board of directors of the First National Bank in New York, who has been a trustee of the Metropolitan Museum of Art for thirteen years, has endowed the museum with a capital sum equivalent to a quarter of a million sterling. The annual income from this, which may be estimated at 56,000 dollars, is to be at the disposal of the trustees. The expenditure of the museum in 1918 was 590,782 dollars, of which 233,000 dollars was contributed by the city of New York.

BY virtue of the Importation of Plumage (No. 2) Order, 1922, the names of certain birds (which are set out below) have been added to the schedule to the Importation of Plumage (Prohibition) Act, 1921, and their plumage can therefore be imported into the United Kingdom without special licence: The common jay; the common magpie; the common starling; the Java sparrow; the West African ring-necked parrakeet; the Chinese bustard; the Green (or Japanese) pheasant; the copper pheasant; and the golden pheasant. The Advisory Committee appointed under the Act, in recommending the addition of the names of the three last-mentioned birds to the schedule, further recommended that the matter should be referred to them again for review after the expiration of twelve months. The Board of Trade accordingly desires it to be known that the addition of these birds is provisional.

IT is announced in the *British Medical Journal* that a gift of 10,000*l*. has been made to aid cancer research by Mr. and Mrs. G. F. Todman, of Sydney, New South Wales, in memory of their daughter. At the request of the donors Sir Joseph Hood has allocated the sum as follows: 4000*l*. to the Imperial Cancer Research Fund, Queen Square, Bloomsbury; 1000*l*. each to the Middlesex Hospital, the Cancer Hospital, Fulham Road, London, the Christie Hospital, Manchester, the MacRobert Endowment, Aberdeen University, and the Cancer Hospital, Glasgow; and 500*l*. each to the Radium Institutes of London and of Manchester.

MR. F. N. PICKETT, chairman of the Management Committee of St. Paul's Hospital, 24 Endell Street, W.C.2, has placed a sum of 15,000*l*. in the hands of trustees to build, equip, and endow a new laboratory for research on various diseases which afflict mankind. The laboratory will be known as the "Pickett-Thomson Research Laboratory," and will be under the honorary direction of Dr. David Thomson, formerly research assistant to Sir Ronald Ross, who has consented to become president of the laboratory. Dr. Thomson, Mr. E. R. Davies, 10 Downing Street, and Mr. E. G. Martens, Genatosan Ltd., have been instrumental in getting a yearly income of about 1500*l*. for the upkeep of the laboratory staff, and other generous business men are now invited to help by giving the necessary money to endow a Ronald Ross research fellowship for biochemical researches on the nature of cancerous growths.

THE Association to aid Scientific Research by Women announces that at its recent annual meeting thirteen essays were submitted in competition for the thousand dollar Ellen Richards Research Prize. Of these essays six were from Great Britain, five from the United States, one from Australia, and one from a Russian working at research in New York. Since its establishment this prize has been awarded five times, three times to American competitors and twice to English competitors. While the prize for 1922 was not awarded, as in the opinion of the judges none of the essays were of the same grade as those to which the prize had been awarded previously, the judges gave such high credit to the paper submitted under the pseudonym of "Excited Atom" that the grant of 1000 dollars, together with honourable mention, was awarded to the author. This is the first time the grant has been made, and it carries with it the stipulation that "the grant shall be made only on the basis of submitted work and shall be used for the immediate continuation or completion of a definite piece of research." To these conditions the author of the paper entitled "An Investigation of the Critical Electron Energies associated with the Excitation of the Spectra of Helium, and their Significance in Relation to certain Modern Views of the Stationary States of the Helium Atom," has agreed, and therefore the sum of 1000 dollars has been sent to Miss Ann Catherine Davies, Royal Holloway College, Englefield Green, Surrey. Miss Davies holds the B.Sc. degree from the University of London, 1915, and received the M.Sc. degree from the same University in 1917.

CAPT. R. AMUNDSEN left Seattle on June 3 in his schooner *Maud* for the Arctic. Before his departure he announced a change in the plans of the expedition. His original intention was to enter the pack-ice north of Bering Strait and drift across to the Atlantic side, a journey which might occupy from two to four years. Last year the *Maud* made an attempt to begin this drift, but sustained injuries which necessitated her return to port. The *Times* announces that Capt. Amundsen now intends to attempt a flight across the polar basin from Point Barrow, the most northerly point of Alaska, *via* the North Pole, to Cape Columbia in Grant Land, where a depot of food has been placed in readiness. The distance is about 1550 nautical miles, and Capt. Amundsen hopes to accomplish it in fifteen hours. Sledging outfit and provisions will be carried in case a descent on the ice is necessary. His sole companion will be the pilot, Lieut. O. Omdal, and the machine will be a Larsen plane built entirely of metal. This aeroplane has already shown that it can remain in the air for thirty-two hours. Provided the weather is clear, this aeroplane reconnaissance should settle the possibility of the existence of unknown islands in the Arctic Ocean. Capt. Amundsen hopes to be able to rejoin the *Maud* next year, and apparently intends to continue the detailed exploration of the polar basin.

NEWS from the Mount Everest expedition published in the *Times* announces that on May 21 Messrs. Mallory, Somervell, and Norton reached an altitude of 26,800 ft. on the northern side of Mount Everest.

This climb was by way of a reconnaissance and did not entail the use of the oxygen apparatus. The height attained is some 2200 ft. below the summit of the mountain, and also about 2200 ft. above the previous record in height, 24,583 ft., which was reached some years ago on K2 by the Duke of the Abruzzi. General Bruce announces that the whole expedition reached the base camp at Rongbuk glacier, at a height of 16,600 ft., at the end of April. An advanced base was established under the peak of Changtse at an altitude of 21,000 ft. The Great Lama of Rongbuk monastery, which is one of the holiest monasteries in Tibet, received General Bruce and several other members of the expedition, and put the most searching questions as to the reasons for attempting the climb. The Lama was satisfied with the view that the attempt was largely in the nature of a pilgrimage, and he gave the expedition his blessing.

Further despatches from Gen. Bruce give details of the fortunes of the Mount Everest expedition before the date of a climb to within some 2000 feet of the summit of the mountain. The weather improved in May, but new difficulties that had to be faced were the desertion of some of the local coolies and the appearance of a mild form of influenza. Yet good progress was made. Gen. Bruce describes the reconnaissance that led to the discovery of a route leading towards the Chang La or North Col of Mount Everest, and the establishment of a camp (No. 3) at 21,000 feet on a broad moraine-covered shelf under the high cliffs of the north peak of Changtse. Col. Strutt, who led this reconnaissance, reports on the difficulties in ascending the East Rongbuk glacier and particularly the side glaciers. But Major Morshead contrived to find a feasible route, and all available hands were to carry supplies up to this advanced base while Messrs. Mallory and Somervell were prospecting the route up to the North Col which was subsequently discovered. In commenting on the weather conditions, Gen. Bruce expresses the opinion that there are normally only two months of suitable weather for climbing in the region of Everest in comparison with at least four months in the West Himalayas. Dr. Longstaff thinks this estimate optimistic, and believes that there is only one month of really suitable weather.

A FULL account of the *Quest's* Antarctic voyage is published in the *Times* in articles by Mr. F. Wild, who is in command of the Shackleton-Rowett expedition. These articles amplify earlier telegraphic despatches. The *Quest* evidently had her full share of the notoriously stormy weather of the Southern Ocean, but, with able handling, avoided any serious mishap. She is evidently of too low power to be of much use among close and heavy pack, but, on the other hand, her small size makes her very suitable for investigating uncharted islands which lie clear of the ice. The visit to Zavodovski Island, the most northerly of the South Sandwich group, did not include a landing, and the weather was too misty to allow a determination of the height. Mr. Wild reports that the island has no good anchorages and very few landing-places. Volcanic activity was noticeable. At the conclusion of the cruise across the Weddell Sea, a visit was made to Elephant Island, where several landings were effected and some geological work carried out. Geological work was also done in Cooper Bay and other bays on the northern side of South Georgia. In addition to the soundings in the Southern Ocean and Weddell Sea, several lines of soundings have been taken off the coast of South Georgia. After calls at Tristan da Cunha and Gough Island, where landings will be made if weather permits, the *Quest* will sail for Cape Town, where she should arrive this month.

THE report of the council of the Illuminating Engineering Society, presented at the Annual Meeting on May 25, contained a summary of useful work, a feature being the variety of topics dealt with during the session and the opportunities afforded for co-operation with other bodies. Thus "The Use of Light in Aerial Navigation" was discussed at a joint meeting with the Royal Aeronautical Society, "The Lighting of Public Buildings" in conjunction with the Royal Institute of British Architects, and the "Use of Light in Hospitals" in co-operation with the Royal Society of Medicine. Attention is also directed to the resumption of international relations in the scientific world, an event of special interest last year being the first technical session of the International Illumination Commission, at which many countries were represented. The presidential address delivered by Sir John Herbert Parsons also aptly illustrated the need for co-ordination of physical and physiological science. As an eminent ophthalmic surgeon, Sir John is familiar with the complexities of vision, and was able to show how important a knowledge of this subject is to the proper study of such problems as photometry and the effect of "glare"—the latter a consideration which enters into daily life in many ways, notably in the use of artificial illuminants and the effect of motor-car headlights.

IN a paper on "The Indigo Situation in India," read on March 24 before the Royal Society of Arts, Prof. H. E. Armstrong criticised strongly the decision of the Government of India to discontinue the work of the Indigo Research Chemist appointed in 1916, and expressed the fear that the action taken resulted not from the prevailing need for retrenchment, but from an inability to appreciate the issues at stake. It will be recalled that Mr. W. A. Davis was appointed to investigate the whole question of indigo production in India, and that arrangements were made for his first inquiries to be concentrated on the preparation of an indigo paste of standard strength and satisfactory fineness of division which would enable the Indian product to compete successfully with the German synthetic indigotin. In spite of special difficulties resulting from the war, a satisfactory product was prepared and Indian indigo paste now has a ready sale in this country. Since 1917 the larger question of the elucidation of the biochemical processes involved in the extraction and manufacture of indigo from the plant has been tackled, as Prof. Armstrong showed, with marked success. The research has a practical value far beyond the indigo question, since it connotes the systematic study of the physiology of a leguminous crop, thus helping to fill a lacuna in agricultural science widely recognised as one calling for early attention in view of the great economic importance of leguminous plants. In the discussion of the paper the chairman (Sir Thomas Holland), while recognising the financial difficulties of the Indian Government, deplored the decision to stop this promising research, and suggested that the funds required from the Government for its continuance would be essentially of the nature of a loan, since the special export cess levied in 1918 for assisting research on indigo could be made to support the cost of the investigation.

A SMALL brochure on "Safety First" in X-ray work, issued by Messrs. Watson and Sons, Kingsway, shows that the recommendations of the X-Ray and Radium Protection Committee have not been in vain. The two Memoranda which have been issued by this Committee are reproduced *in extenso*, and it is evident that Messrs. Watson are doing their best to induce their clients to accept the protective measures prescribed. This is a welcome step in the right direction, for if radiological work throughout the country is to be free of risk to those engaged in it, it will be brought about only by those in charge of the installations insisting upon guarantees of safety. These guarantees can be provided at a small percentage cost of such installations, and we look confidently to the time when the National Physical Laboratory Certificate of Safety will become a *sine qua non* for practical work of this character.

SIR WILLIAM TILDEN and Prof. J. C. Philip are editing for Messrs. George Routledge and Sons, Ltd., a new series of volumes dealing with chemistry. Those for which arrangements have so far been made are :—"The Metastability of Matter," Prof. E. Cohen; "Oxidation and Reduction in Organic Chemistry," Dr. O. L. Brady; "Physical Aspects of Organic Chemistry," Prof. T. M. Lowry; "Atomic and Molecular Structure in Relation to Properties," Dr. I. Langmuir; "The Energy Factor in Chemical Change," Prof. J. R. Partington; "Space Formulæ in Carbon Compounds," Prof. J. F. Thorpe and Dr. C. K. Ingold; "Adsorption," Prof. J. W. M'Bain; and "The Theory of Quantitative Analysis and its Practical Application," Prof. H. Bassett.

Our Astronomical Column.

A VERY MASSIVE STAR.—A paper by Prof. Plaskett on a spectroscopic binary of very high mass was read by Prof. Newall at the meeting of the Royal Astronomical Society on June 9. The star is of the sixth magnitude, and shows two spectra with considerable difference of brightness, but both measurable. It is difficult to imagine any explanation of the double spectrum other than duplicity of the star, as the spectral type indicates a fair amount of condensation, and the distance between the stars is of the order of half an astronomical unit. As there is no evidence of light-variation, it is presumed that eclipses do not occur; it is therefore estimated that we see the orbit open to the extent of some 15°. The minimum values of the masses are given as about 70 times that of the sun for each component, the combined mass being about four times as great as that of any previously determined.

THE ROTATION PERIOD OF MARS.—Mars is the only planet of which the rotation period is exactly known. The periods of Jupiter and Saturn are often confidently stated to the fraction of a second, but it must be remembered that these values represent merely the rates of drifting and changeable spots in the vaporous envelopes of the two planets. We cannot perceive anything of the material features forming the real surface scenery of either Jupiter or Saturn, for they appear to be continuously veiled.

Mars, however, displays its actual surface markings to our view. We detect objects on its disc which are similar in shape and position to those which were discovered and delineated by Hooke, Cassini, and Huygens in the last half of the seventeenth century. There can be no doubt that the markings seen today are identical with those traced by the old observers about two and a half centuries ago.

The rotation period of Mars, according to the best determinations, is 24 hours 37 minutes 22·6 seconds, but there is a suspicion that this is too long, to the extent of about one-twentieth of a second.

RADIAL MOTIONS OF SPIRALS AND CLUSTERS.—C. Wirtz contributes an article on this subject to *Astronomische Nachrichten*, 5153. He quotes figures for 29 spirals of which only four show approach, and deduces a systematic recession of 840 km./sec., finding for the sun's velocity 712 km. towards R.A. 54°, N. Decl. 83°; galactic Long. 95°, N. Lat. 23°. Omitting two doubtful figures the velocity, longitude, and latitude become 693 km., 90° and 29°, a shift of 7° from the first result. It appears that the nebulæ in lower galactic latitudes tend to approach, those in high latitudes to recede, while the brighter ones (that is, either the nearer or the more massive ones) tend to approach and the fainter ones to recede.

The radial motions of ten globular clusters indicate a systematic approach of 55 km./sec., and give a solar velocity of 348 km. towards R.A. 11°, N. Decl. 77°, galactic Long. 90°, N. Lat. 15°; or, omitting the systematic motion of approach, the velocity, longitude, and latitude become 373 km., 79° and 19°, only 12° from the first point. The number of clusters is too small for trustworthy analysis, but there is some evidence of greater velocity in low galactic latitudes, and of increasing velocity with increasing distances (using Shapley's parallaxes). There is an interesting resemblance between the apices derived from spirals and clusters, but the great difference in velocities leaves it doubtful whether it has any significance.

The author points out that trustworthy proper motions of the above spirals would enable a good estimate of their distances to be derived; a preliminary analysis of the few proper motions available (*Astronomische Nachrichten*, vol. 206, p. 114, 1918) gave for the solar apex R.A. 110°, N. Decl. 34°, annual motion 0·027″. This point is 52° distant from the first point found from radial motions. This discordance is not too discouraging considering the meagreness of the material, and the large discordances that are found for the apex relatively to the stars belonging to the galactic system.

Research Items.

A DOG-TOOTH BREAST ORNAMENT.—The *Australian Museum Magazine* (vol. i. No. 4) gives an account, with a photograph, of a remarkable form of breast ornament procured at Rabaul, New Britain, and now on loan at the Museum. It consists mainly of canine teeth of the island dog, the teeth having been perforated and attached to a plaited fibre string base, 22½ by 7¾ inches in size. At the angles and upper centre are pendants made of teeth and shells. As only four canine teeth occur in an individual, at least 130 dogs contributed to the ornament. When worn by the chief, it is suspended from the neck by the attached finely plaited cord. It was considered of great value, and no doubt formed an heirloom of much importance.

THE CHUCHKI NATIVES OF NORTH-EASTERN SIBERIA.—In the Journal of the Washington Academy of Sciences (vol. xii. No. 8, April, 1922), Mr. H. V. Sverdrup gives an account of the Chuchki tribe, collected on Capt. Amundsen's expedition, which left Norway in 1918 with the intention of following the coast of Siberia eastward to the vicinity of Bering Strait. At Ayon Island, about 700 miles west of Bering Strait, the Chuchkis were found in possession of herds of domesticated reindeer. The tents in which they live, summer and winter, are well adapted to their nomadic life and climatic conditions, and they are heated by a flat lamp of the Eskimo type. Reindeer supply practically all their food, the animals being caught with lassoes which the young men handle with wonderful skill. They do not count years, so nobody knows his own age, but they count thirteen full moons in the year by the twelve joints on both arms from the finger tips to the shoulders, including the head for the thirteenth month. They kill old people, not through cruelty, but as an act of mercy. His sledge, axe, knife, tobacco pipe, and teacup are buried with a dead man. They are quite contented with their mode of life, and have no desire to change their habits or leave their country. They do not care for the outer world, so long as it is willing to exchange tea and tobacco for fox skins. "Civilisation would not bring them any good, so it would be well if they might remain as primitive as they are."

HEALTH IN THE TROPICS.—A paper on climate and health in the South American tropics by Dr. F. L. Hoffman was presented before the American Meteorological Society at Toronto in December 1921, and a summary is given in the *U.S. Monthly Weather Review* of January last. The author considers that false impressions prevail as to the climate of the Amazonian basin, and much which has been written is misleading and a deterrent to the settlement of a vast region with enormous economic possibilities. The climate is warm throughout the larger portion of the year, but the warmth is limited mostly to the daytime, while the nights are often distressingly cool. The chief causes of ill-health in northern South America are apparently not tropical diseases but respiratory and rheumatic affections. Chilly nights cause ill-health and result in a high mortality. It is estimated that the night temperatures are about 30° lower than the day readings. With regard to humidity, it is stated to be generally far from such a serious detriment to health and comfort as is assumed, but when a high humidity coincides with a high temperature there is a considerable increase in infant mortality.

MOSQUITO INVESTIGATION.—Of the three species of Anopheles mosquitoes capable, under certain conditions, of communicating malaria, two, *i.e.* *A. maculipennis* and *A. bifurcatus*, stand convicted. The third group, *A. plumbeus*, or *A. nigripes*—a sylvan species—has been less known, although strongly suspected. Recent investigations by Blacklock and Carter of Liverpool, however, tended to establish not only the possibility of their capabilities as disease carriers, but that they were more abundant in England than had been supposed. Following up this discovery, the Mosquito Investigation Committee of the South-eastern Union of Scientific Societies has for nearly two years been engaged in inquiring into the habits, breeding places, and distribution of the species in south-east England, at the instance of the Ministry of Health. The three reports of the Committee have established that the larvæ of the species is extensively distributed in certain areas, many breeding places having been located, and that eggs, after becoming dry, hatch on re-immersion. Thus drought will not destroy them. The final report to the Ministry of Health is nearly due, the Committee has issued a Circular (No. 6) with the object of clearing up some points still in doubt. The more important are:—(1) Whether the species deposit their eggs (*a*) on water, (*b*) on floating or stationary objects, or (*c*) on the wet margins of water-holes. (2) The retention of vitality of the eggs after desiccation. (3) Information as to the possible hibernation in the egg stage. We may add that the late Mr. A. W. Bacot, whose death in Egypt last April, while engaged on typhus research for the Egyptian Government, was so tragically sudden, was the chairman of, and took great interest in, the Committee's work. The present chairman is Dr. Clarence Tierney, and the hon. secretary is the Rev. T. W. Oswald-Hicks of Lesware, Linden Road, N.15, who will be glad of replies to any of the queries.

THE SMALLEST HORNED DINOSAUR.—After skilful work extending for over a year, Mr. Norman Boss has completed and mounted for the U.S. National Museum a restored skeleton of the smallest horned dinosaur that has yet been discovered. This skeleton of *Brachyceratops montanensis* is the subject of a short description, with illustrations by Mr. C. W. Gilmore (Proc. U.S. Nat. Mus., vol. lxi.). The original remains from the Upper Cretaceous of north-western Montana, first described in 1917 (U.S. Geol. Surv. Prof. Paper 103), have been supplemented where necessary from other sources and result in the building up of an individual, admittedly immature, 5 ft. 4 in. long (the skull contributing 22 in.) or about the length of the head alone of Triceratops, as shown in the view of the two skeletons juxtaposed. The height of Brachyceratops at the hips is given as 30 in., but we cannot help thinking that like other of these American reptiles of olden days it has been mounted too upstanding. In a model representing the animal in the flesh (also here figured) an attempt has been made to depict the character of the scaly skin.

FOSSIL BIRDS FROM PORTO RICO.—The "Bird Remains from the Caves of Porto Rico" have been investigated and described by Mr. A. Wetmore (Bull. Amer. Mus. Nat. Hist., vol. xlvi.). The specimens were obtained in 1916 by Mr. H. E. Anthony in connection with a natural history survey of the island of Porto Rico, undertaken by the New York Academy of Sciences in co-operation with the Insular Government of Porto Rico. The number of species is 42, of which six were described as new at intervals during 1918 to 1920, the diagnoses being here repeated, while seven belong to extinct forms. The great mass of bones appears to have come from owl pellets; those of birds larger than a thrush or blackbird are comparatively few in number, and may have represented the prey of man, or have been introduced by accident. They vary in age, the author considers, from 100 to more than 2000 years.

MOTOR HEADLIGHTS WITHOUT GLARE.—Some researches on motor headlights were summarised by Mr. H. S. Ryland at the recent discussion on this subject before the Optical Society (NATURE, May 27, p. 694). Mr. Ryland remarked that glare was largely a matter of comparison. Two of the chief factors, the "after image" effect and the regions of insensibility surrounding the image of a bright object, varied with the size of that object. He concluded from his experiments that for a given brightness of the beam, glare varied as the square of the apparent diameter of the course. Mr. Ryland has accordingly designed a lamp with a 2 in. aperture, all the available light (less about 4 per cent. and the ordinary reflection losses) being included in the beam, the upper limit of which is normally horizontal. Tests on the road showed that such lamps yielded adequate illumination and yet could be passed by other road users without discomfort.

EFFECT OF STRESS ON THE HEAT CONDUCTIVITY OF METALS.—The measurements of Smith in 1909 (*Physical Review*, vol. 28, p. 107) and those of Johnstone in 1916 (*Philosophical Magazine*, vol. 29, p. 195) on the effect of stretching on the conduction of heat along wires showed that for most of the commoner metals stretching increased the conduction by about 7 parts in a million for each megadyne per sq. cm. of stress up to the elastic limit. Lussana's measurements in 1918 of the effect of hydrostatic pressure on the conductivity (*Nuovo Cimento*, vol. 15, p. 130) gave increases as the pressure increased at approximately the same rate up to pressures of about 3000 megadynes per sq. cm. In the April issue of the Proceedings of the American Academy of Arts and Sciences, Dr. Bridgman gives an account of his recent measurements of the effects of pressures up to 12,000 megadynes per sq. cm. on the heat conductivities of eleven metals. He finds that pressure increases the conduction in the case of lead, tin, iron, and decreases it in the case of copper, silver, nickel, bismuth and antimony. The rates of change lie between 2 and 12 parts in a million per megadyne increase of pressure.

REGULATING RESISTANCES. — A comprehensive catalogue of regulating resistances, ranging from large banks of grid resistances to small adjustable rheostats, has been issued by Messrs. Isenthal and Co. (Denzil Works, Willesden). The method of construction of a tightly wound single layer of bare wire on an insulating cylinder with a spring sliding contact of ample dimensions moving axially over the wire, is adopted up to quite large sizes for field regulating resistances of the type in which only the regulating hand wheel is in front of the board. These are made, either with a slow motion screw gear, or actuated by wires so that one turn of the wheel covers the whole range. Dimmers for incandescent lighting with the same type of resistance are also illustrated. The large grid type resistances are made up in a variety of forms for different purposes, such as meter calibration, artificial loads, and other testing work. In many of these, control is effected by putting a varying number of sections in parallel by a circular switch of substantial construction with a moving contact segment, which passes under a series of radially disposed carbon contacts resembling dynamo brushes in holders of the box pattern.

VISCOSITY AND FLASH-POINT APPARATUS. — Messrs. Gallenkamp of 19-21 Sun Street, Finsbury Square, have sent us an illustrated pamphlet describing standard apparatus for determining the viscosity and flash point. The increasing importance of petroleum products for motor fuel, lighting, heating, and lubricating purposes, together with the fact that the industry is rapidly assuming considerable proportions in this country, renders the possession of accurately standardised testing apparatus a matter of great interest, and Messrs. Gallenkamp are to be congratulated on their foresight in putting before the laboratory staffs of the oil refiner and the oil consumer the useful compendium under notice. It is unfortunate that this country, the continent of Europe, and the United States have each developed a type of viscometer which at best is merely empirical. All suffer from the drawback of a capillary far too short which is difficult to clean, and none of the instruments give absolute readings. The tables of comparison between the three types, Redwood, Engler, and Saybolt, are only approximately correct, and the range of observations is relatively narrow. Until, however, a universal viscometer has been devised the three instruments mentioned will retain their places. The pamphlet gives instructions for using Redwood's viscometer and might very well have added concise instructions for the operations of the other two. The recently described instruments of Stammer and Michell are also described and quoted. The list includes the well-known flash-point apparatus of Abel, Abel-Pensky, and Cray, and the standard distillation tests of Engler and the British Engineering Standards Association.

A CRYSTALLOGRAPHIC INDEX.—"A List of New Crystal Forms of Minerals," by Dr. Herbert P. Whitlock, was issued in April (1922) as a separately bound brochure, from the Bulletin of the American Museum of Natural History (vol. 46, Art. II., pp. 89-278). Such a systematic compendium of new crystal "forms" (groups of faces of equivalent value with respect to the symmetry) should prove of great value. Often it is very difficult, when measuring crystals of known minerals from new localities, or crystals exhibiting specially interesting features although from known localities, to be quite sure, on discovering what are apparently new and hitherto unobserved forms, that these forms have in truth never been previously observed. Crystallographic literature is now so voluminous and complex, so scattered in so many different publications, that it is a matter of great labour to be thoroughly conscientious in seeking for previous records of the observation of these possibly new forms. Indeed, it frequently happens that such a search is not as thorough as the case requires, and in the actual compilation of this list Dr. Whitlock has found many cases where forms cited as new, and forming the sole subject of a paper supposed to be of original investigation, have proved to have been previously described—and more than once—by other authorities. The scope of the compilation includes the thirty years from 1890 to 1920. The thanks of both mineralogists and crystallographers are due to Dr. Whitlock for so useful a production, which is rendered all the more valuable by the fact that full references to all the original authorities are given. Together with the abstracts of crystallographic papers which are being published by the Mineralogical Society of London, and the lists of new minerals and new forms which from time to time are being included in the *Mineralogical Magazine*, we have now the material in compact form wherewith to set in order the whole record of crystallographic achievement, and to remove the stigma of "chaotic literature" which has been with some truth attached to the literature of this subject in the not too distant past.

Iron Ore in Europe.[1]

By Prof. J. W. GREGORY, F.R.S.

THE political redistribution of the iron ores and coal supplies of Central Europe by the late war was one of the results of most portentous import to the future of the world. A clear summary of the available evidence by a well-qualified expert who represents so impartial an authority as the Geological Survey of the United States, is a valuable addition to the literature of political geology. The evidence on which the memoir is based is of very unequal value, for any individual synopsis of the iron ore position must be based on the published records, which are of varying quality in different countries; moreover, the author remarks that the Russian and Slavonic literature is available to him only at second hand.

Despite its deficiencies, inevitable in any review of the ore supplies of a continent which is such a political patchwork as Europe, Roesler's memoir is a valuable supplement to the monograph on the iron ores of the world which was published in 1910 by the International Geological Congress. Mr. Roesler has brought the information up to date and presents it in a more compact form. Moreover, he expresses the results graphically in a series of sixteen clear and instructive maps which show the distribution of the ore fields and the known and estimated qualities of ore in each.

The outstanding feature of the present position is the overwhelming predominance of France in Europe as regards supplies of iron ore. In this respect France among the nations of the world stands second only to the United States. "France has the largest reserves. She stands so clearly above the other countries of Europe that there is no question of her holding first place." The French known, probable, and possible iron ores are estimated at a total of 4,369,600,600 metric tons, a total which amounts to 35·2 per cent of the iron ore reserves of Europe; the British Isles take the second place with 18·2 per cent., Sweden is third with 12·5 per cent., the German Republic fourth with 11·1 per cent. According to the author's classification of European countries Spain is fifth with 5 per cent., for he subdivides Russia, with a total of 8·3 per cent. into the Central, Southern, and Ural regions. The Russian iron fields are so scattered that it is a great convenience to keep them distinct, for they may be developed as separate industrial areas each supplying a different group of provinces.

The British supplies accepted by Roesler are smaller than some estimates; he admits that the iron included in these estimates is present, but he considers that some of the material is of so low a grade that it should not be regarded even as possible ore. He remarks that his own figure for possible ore, 2254 million metric tons, may be too large.

Germany has fallen to the fourth place, and the unfavourable conditions of a large proportion of its ore has led to the prediction that it cannot be worked and that the future of Germany is "only that of an agrarian state." The author dismisses this hypothesis with the remark that Germany "has shown her capacity to use her resources thoroughly enough to justify the conclusion" that the ores left her will be fully exploited.

The large volume of French ores is due to the sedimentary ores in the Jurassic field of Lorraine. The sedimentary ores of Europe range from the pre-Cambrian beds at Krivoi Rog in Southern Russia to the Pliocene ores of Kerch in the Crimea, and representative beds occur in most of the geological periods; but the most important supply comes from the Jurassic, which contains 46 per cent. of the European sedimentary ores. These ores contribute 70 per cent. of the total; the replacement ores amount to 12 per cent.; the contact deposits and magnetites, of which the genesis is doubtful, amount to 16 per cent.; in reference to these ores the author appears to have overlooked the fact that some of the large Lapland masses consist of titaniferous magnetite, and to overstate the strength of the case for the magmatic origin of the Kiruna ores.

The iron ore reserves are best known in Europe, and taking this quantity as the unit, the supply in North America would be represented by three, in South America by two, in Asia by three-quarters, and in Africa by one-sixth. In both Africa and Asia, however, the amount may be expected to be increased greatly by further exploration.

The reserves of iron ore in the world are estimated as sufficient to maintain the production of 1913 for 1000 years; but if the output of iron increases at the pre-war rate of 5 per cent. per annum, the supply would be exhausted in about 130 years; but a fall in the rate of increase appears inevitable, and consequently the ore reserves will have a longer duration.

The progress of the iron industry is of primary importance to the world and its future, and is especially difficult to forecast. Hitherto, Europe has had the advantages over the United States of cheap labour and of the proximity of ore and coal. In spite of this, the United States has gained the supremacy in the iron industry through economy in labour by mass production and through the large local market for manufactured goods which is maintained by the high wages paid. Europe has now to face conditions when labour is no longer cheap, and when the low efficiency that accompanies low wages cannot be as quickly altered. The main European iron field is now separated politically from the Westphalian coal field. The part of the Lorraine field which was French before 1914 was handicapped by lack of labour, and most of the miners were Italian; and unless adequate labour can be secured for the mines, and the Westphalian coal and the Lorraine iron can be brought together under favourable economic conditions, the development of the field will be jeopardised. The Belgian iron industry is dependent on German coal and on imported ore. Austria has no coal, and her considerable iron ores will probably be exported to feed the German furnaces. The three chief ore-exporting countries, Sweden, Spain, and Norway, will probably be but little disturbed by the new conditions, which will help the Norwegian ores, since most of them need concentration and briquetting.

The large British reserves of ore, though they have the advantage of proximity to coal, may be useless should the high price of fuel render it profitable only to melt high-grade ores which must be imported. The British iron industry will no doubt adjust itself to the new conditions, but Mr. Roesler predicts that the transition will be troublesome and painful. The outlook of the iron industry in this country is indeed dismal if costs of production can be lowered only at the expense of coal and labour. That there are opportunities for saving in other ways appears clear from the fact that whereas in the United States each blast furnace has an output of 120,000 tons per annum, in Germany it is 55,000 tons, and in England only 28,000 tons.

Mr. Roesler's work concludes with an excellent bibliography.

[1] "The Iron-Ore Resources of Europe," by Max Roesler, Dept. of the Interior, U.S. Geol. Surv. Bull. 706, 1921, pp. 152+xix. pls.+32 figs.

The Photographic Plate.

THE third Hurter and Driffield memorial lecture was delivered in the theatre of the Royal Society of Arts, before the Royal Photographic Society, on May 9, by Prof. The. Svedberg of Upsala, who took for his subject "The Interpretation of Light Sensitivity in Photography." After a short general discussion of light sensitiveness from a purely photochemical point of view, particularly with regard to Einstein's law of the photo-chemical equivalent, the lecturer distinguished between *plate*-sensitiveness, *grain*-sensitiveness, and sensitiveness of the *silver-halide material* of the grain. The first is the sensitiveness that concerns the practical photographer, but the third, together with some purely physical circumstances, determines the quality of the plate, and is that to which the emulsion maker should devote most of his attention. It has been recognised only quite recently that there is a sensitiveness of the haloid which is independent of the physical properties of the film and of the size of the grains or particles.

From a statistical point of view, and with single emulsions, that is emulsions prepared at once and unmixed with other emulsions, there is a certain relationship between sensitiveness and the size of the particle, the larger grains being more sensitive than the smaller. But though the probability for a grain to become developable is greater in the case of a large grain than in the case of a smaller one, yet taking any two individual grains one cannot tell whether, on exposure, the larger or the smaller will be the first to become developable. This is accounted for by the fact that development sets in at discrete points in the halide grain and progresses from these points until the whole of the grain is converted into metallic silver. One such starting-point is sufficient to render the grain completely developable.

These centres of action are located and counted by stopping development at a very early stage, and superposing a photograph of them on a photograph of the same particles taken in a deep red light before the exposure. A statistical study of the distribution of these centres gives the interesting result that within each size-class of halide grains they are distributed according to the laws of chance. The lecturer adds, "Whether the developable centres are pre-existent in the grains in the form of especially light-sensitive points, or whether their number and position in a grain is entirely determined by the light only—eventually by the haphazard distribution of the light quanta—we are so far not able to tell."

For various size-classes of grains in the same emulsion, the average number of centres increases with the size of the grain. This leads to the assumption that as a rule all the grains of a single (unmixed) emulsion are built up of the same silver halide material of the same light sensitiveness, the larger grains being more sensitive than the smaller ones merely because of the greater probability that a larger grain may contain one, or more than one, developable centre. The average number of centres is found to be proportional to the surface area of the grains.

By the use of X-rays, which are so little absorbed that the grain is exposed to their action through its whole mass, the available centres are found to be on the surface of the grain, so that the sensitiveness of a grain is determined entirely by its surface layer. By finding the number of centres per unit area of grain surface it is possible to find the sensitiveness of the silver halide material of an emulsion, independently of the size of its grains, and this has been done for three different emulsions, demonstrating clearly the great differences in sensitiveness to light of the haloid bromide material in different emulsions. Such estimations are likely to be of value to the emulsion maker in his endeavour to prepare emulsions of new and desirable properties.

The lecturer concluded his discourse by pointing out many questions that still remain to be answered in order to perfect our knowledge of the photographic plate and its sensitiveness to light. C. J.

Agricultural Research at Aberystwyth.

THE new agricultural buildings and the Welsh plant-breeding station of the Agricultural Department, University College of Wales, Aberystwyth, were formally opened on May 20 by the Minister of Agriculture, the Rt. Hon. Sir Arthur Griffith Boscawen, Bart.

The Welsh plant-breeding station owes its origin to the foresight of Sir Laurence Philipps, Bart., of Llanstephan House, Boughrood, Radnorshire, who generously provided an endowment of 10,000*l.* for the purpose, and who further assists the station with an annual donation of 1000*l.* to its funds for a period of ten years. In 1920 the station was recognised by the Ministry of Agriculture as a research institution entitled to grants-in-aid from the Development Fund, and by virtue of a capital grant and annual grants-in-aid, in addition to Sir Laurence Philipps's generous endowment, it has been possible to equip the station in a thorough and up-to-date manner.

The work in connection with the new agricultural buildings and the plant-breeding station was started in 1919. The buildings are now completed and consist of commodious and well-equipped laboratories for research in agricultural botany and agricultural chemistry, as well as lecture rooms, and a library. The laboratories of the plant-breeding station are also arranged for in the buildings and have been specially equipped in a manner suitable for the researches which are in progress. The buildings occupy the site of the old foundry near the station—practically all the laboratories and lecture rooms being, in fact, part of the original building—the alterations having been skilfully made by Mr. Bassett. In addition to the self-contained building which is now solely occupied by the Agricultural Department, Nantcellan Farm, Clarach, has been acquired for the use of the teaching department, and Frongoch Farm for the Welsh plant-breeding station. The former is situated in the Clarach Valley about three miles from Aberystwyth. It comprises about 142 acres of pasture and arable land together with about 28 acres of woodland. The main object of the farm is to furnish facilities for giving demonstrations to students and for carrying on experiments and research. It is considered eminently suitable for the purpose for which it was obtained. The latter is a farm of 92 acres and is used entirely for experimental purposes in connection with the Welsh plant-breeding station. In addition, the plant-breeding station has about 5 acres of garden ground situated a few minutes' walk from the laboratories. At the gardens the equipment consists of a large span greenhouse and an up-to-date pot culture station, together with cages and other essentials.

The formal opening marked a great advance in the facilities afforded in Central Wales for both the student and for research in the problems influencing productivity in the Principality. The investigations conducted at the Welsh plant-breeding station are primarily intended to be of service to agriculturists in Wales, and are therefore bound to be of equal value to farmers generally in elevated areas in regions of high rainfall.

The chief aim of the station is to investigate problems connected with herbage plants with the view of producing improved strains of such important plants as red clover, lucerne, the rye grasses, cocksfoot, and all other grasses suitable for inclusion in mixtures for temporary and long-duration pastures. Researches on these lines are now well advanced, interesting reports having been issued from the station on the work so far conducted. The oat crop is also receiving detailed attention; the possibility of extending the practice of growing winter oats is being explored, and endeavour is being made to produce hardier, earlier, and stiffer-strawed varieties suitable to Welsh conditions. It should be stated that the potato, barley, and root crops are not being studied at the station.

Welsh agriculturists must not expect to see the full benefits from Sir Laurence Philipps's foresight and the developments that have followed from the foundation of the station until after the lapse of a number of years—for plant-breeding is a slow and laborious business based on the gradual building up of strains each of which can only be the outcome of prolonged investigation.

The Royal Observatory, Greenwich.

THE report of the Astronomer Royal presented at the annual visitation of the Royal Observatory, Greenwich, on June 3, deals with the year ended on May 10. The observations for the seven-year star catalogue, 1915–1921, have been concluded, practically all the stars having been observed at least seven times; they include all stars in the Backlund-Hough list north of declination −28°. The determination of their proper motions is now in progress. The working catalogue in use since January last includes all the stars brighter than the eighth magnitude (with some fainter ones in sparse regions) between North Decl. 32° and 64°. It will be remembered that the zones from N. 24° to N. 32° and from N. 64° to N. 90° were covered in recent Greenwich catalogues. The epoch 1925 is adopted for all catalogues about the present time, in accordance with a resolution of the Astronomical Union.

A change has been made in the method of determining azimuth error of the transit-circle. Formerly it depended upon observations of the nine standard polars within 3½° of the pole; a list has now been made of 70 stars the polar distances of which lie between 13° and 45°, most of them bright enough to be observed in daylight; as many of these as practicable are observed daily at both culminations, using the travelling-wire micrometer, thus greatly reducing the personality that was present in the previous method of hand-tapping used for the close polars. The latter stars will still be observed for place; their positions will no longer depend solely on double transits of Polaris, which were only obtainable for restricted periods of the year. The clock-star list has been modified by removing two very low stars and inserting eleven new ones to fill gaps.

The moon was observed on 126 nights; the average correction required to the Nautical Almanac value of the longitude is 13·38″. After the end of 1922 Brown's tables will be used in the Almanac, and there will be a discontinuity in the errors.

Eighteen consecutive divisions of the transit circle, covering an arc of 1½°, have been obliterated from some unknown cause in recent years; new divisions have recently been cut with a small steel scriber that was screwed to the bracket holding the pointer. The new divisions are very sharp, and the errors of graduation are very small.

The distribution of temperature in the neighbourhood of the instrument has been studied; thermometers are now read outside both the north and the south walls of the observing room; they frequently show differences of some degrees, depending apparently on the direction of the wind; it is therefore somewhat difficult to know what temperature should be employed when computing refraction.

The recently published volumes dealing with the results of the observations made with the Cookson floating telescope between 1911 and 1918, and with the observations and orbits of the double stars observed with the 28-inch refractor since 1892, have already been noticed in NATURE. The latter observations are being continued, 253 pairs having been measured during the year, of which 56 had separations less than 0·5″.

The Thompson equatorial has been used, as before, for the photographic determination of stellar parallaxes. In all, 896 plates have been measured during the year, and the parallaxes of 48 stars deduced, with a mean probable error of 0·009″; altogether 142 parallaxes have now been determined with this instrument.

The 30-inch reflector has been used for a photographic determination of the wave-lengths of maximum photographic intensity in stars of different colours. A grating of steel wire, 1·42 mm. in diameter, was used to produce diffraction images, the effective wave-length being found from the separation of images; the results, which were communicated to the Royal Astronomical Society, indicate that the graph connecting wave-length with spectral type is distinctly non-linear. An extension of this work, suggested by Prof. T. R. Merton, is now being commenced. A 7-inch prism has been borrowed from the joint permanent Eclipse Committee; this will be mounted in front of the 6-inch Franklin-Adams lens, for which an aluminium camera has been made; a coarse wire-grating will be placed in front of the prism.

The astrographic equatorial was used to complete the magnitude determination of stars in the Harvard polar sequence. The results, which are in good accord with those obtained at Mt. Wilson, were published in the Mon. Not. R.A.S. of last November. The instrument has now been taken to Christmas Island for the eclipse of next September. The latest report stated that the mounting had been set up, except part of the driving clock. It has been arranged to take photographs of the Kapteyn areas in zones 15° N., 15° S., and 30° S. in order to connect the northern and southern magnitude scales.

Sunspot activity declined considerably during the year; there were, however, some prominent groups, of which the largest two crossed the central meridian on 1921, May 14, and 1922, March 2.

The mean values of the magnetic elements for 1921 and the three previous years were as follows:

	Dec. W.	Hor. Force. (C.G.S. Units.)	Vert. Force. (C.G.S. Units.)	Dip.
1918	14° 27·8′	0·18464	0·43247	66° 52·8′
1919	18·2′	0·18454	0·43242	53·3′
1920	8·6′	0·18456	0·43192	51·8′
1921	13° 57·6′	0·18449	0·43183*	52·0*

* Denotes that these values are provisional.

The mean temperature for the year ended on April 30 was 50·9° F., or 1·4° above the average. October was 6·3° above the average, the warmest October for 80 years. The rainfall was 16·49 in., or 7·75 in. below the average.

Wireless time signals from Eiffel Tower, Nauen, Bordeaux, Lyons, and Moscow are recorded on a syphon recorder; a special series of rhythmic signals from Lyons, for longitude purposes, was observed between June 20 and July 12.

The Carnegie Trust and Scientific Research.

THE twentieth annual report (1920–21) of the Carnegie Trust for the Universities of Scotland contains several points of interest. In relation to scientific training and research there are three important matters to distinguish, namely, buildings and equipment; scholarships and fellowships; and part-time research assistants and lecturers. This last is a new feature of the research scheme and is to be commended as combining facility for research with experience in teaching.

So far there are thirteen of these combined posts in the four universities of Scotland and all in the departments of chemistry and physics. They are covered by an annual outlay of 3600*l*. Of the 14,419*l*. awarded to the four universities for research fellowships, scholarships and grants, nearly half is given to history, the remainder being fairly well distributed among the departments of physics, chemistry, natural history, and medicine. Of this sum 26 per cent. goes to St. Andrews, 16 per cent. to Glasgow, 15 per cent. to Aberdeen, and 43 per cent. to Edinburgh. Thus Edinburgh distinctly leads in research; but activity is specially noteworthy in St. Andrews, which, as regards the number of students in attendance, is much the weakest of the four.

As is natural, the conditions of tenure of scholarships and fellowships, which cannot be held with other remunerative appointments, lead to many resignations in the course of the year, so that of the sum initially awarded only a total of 8123*l*. has been expended. From the point of view of research this is to be regretted. The further development of the part-time assistantship scheme may in future supply a remedy.

Under the quinquennial distribution, the schemes of the universities and other institutes of learning include buildings, equipment, libraries, and endowments of chairs and lectureships. These require on the average 50,000*l*. per annum; and of this sum 72 per cent. is devoted to buildings. For new buildings in the Faculty of Arts and the Department of Zoology, Glasgow University has appropriated 91 per cent. of its share; and the new King's buildings for chemistry are absorbing 81 per cent. of Edinburgh's share. The ultimate influence of these developments on scientific research will no doubt be great; the more immediate effect will be a demand for increase of staff and a corresponding increased expenditure in the teaching of science.

Of the 65,000*l*. expended under what is known as Clause A, nearly 13,000*l*. is devoted directly to individual research; while of the remainder by far the greater part is being used for providing suitable laboratories, for extending libraries, for endowing chairs and lectureships, and for helping in the publication of books and memoirs, the influence of which on scientific progress cannot be over-estimated. In these respects the Carnegie Trust for the Universities of Scotland seems to be fulfilling admirably its high function in the advancement of science.

University and Educational Intelligence.

CAMBRIDGE.—Dr. Roderick, Emmanuel College, has been reappointed demonstrator in surgery, and Mr. E. A. Milne, Trinity College, has been appointed University lecturer in astrophysics. A grant of 50*l*. from the Worts Fund is to be made to Mr. J. L. Evans, St. John's College, towards the expenses of a journey to make researches on the economic conditions of south, central, and south-eastern Europe since the treaties of peace, and on the question of the protection of minorities under the various treaties in the same region.

It is proposed to confer Honorary Degrees on H.R.H. the Duke of Aosta, K.G., and on Col. Sir Gerald Lenox-Conyngham.

The Statute giving the University power to confer by diploma titles of degrees upon women students of a recognised institution has now been approved by His Majesty the King in Council. The University now has power to name the recognised institutions and to lay down the conditions under which students of these institutions may qualify for these titles. It may admit members of such institutions to instruction in the University as well as to the use of its libraries, laboratories, and museums, in such numbers and on such conditions as it may determine. It may allow past residence kept and examinations passed by students of Girton College or of Newnham College as partial or complete qualification for titles of degrees.

Thus after four years of struggle does the University yield what the supporters of women's higher education asked twenty-five years ago, and one is tempted to wonder what the next twenty-five years will bring, and how long it will be before the next step in this old controversy will be taken.

Col. Sir Gerald Lenox-Conyngham, Trinity College, has been appointed reader in geodesy, and Mr. W. Dawson, Gonville and Caius College, has been re-appointed reader in forestry. Mr. C. Fox, Christ's College, has been re-appointed principal of the Cambridge University Training College for Schoolmasters.

Sir Ernest Moir has offered to endow a prize in the Engineering Department in memory of his son, Rex Moir, Gonville and Caius College, who was killed in the war. This offer has been accepted.

EDINBURGH.—On Thursday, June 8, Prof. T. H. Morgan, professor of experimental zoology in Columbia University, New York, delivered a lecture in the Natural History Theatre of the University of Edinburgh to a large audience of the staff and students on "Old and New Ideas about Heredity." The vice-chancellor, Sir Alfred Ewing, presided. Prof. Morgan gave an account of the more recent developments of the work on inheritance in Drosophila which is being carried on in his laboratory. After showing that the facts of inheritance lead to the conclusion that the Mendelian characters are carried by the chromosomes and that the hereditary factors or genes are arranged in a linear series in each chromosome, he discussed briefly the evidence available for forming a rough estimate of the upper limits of size of the factors. At the close of the lecture the dean of the faculty of law presented Prof. Morgan to the vice-chancellor for the honorary degree of LL.D. The dean remarked that the ceremony was reminiscent of the graduation proceedings of an older time when the candidate for university honours was required to maintain against all comers a thesis upon some abstruse subject of his choice, and he thought the audience would agree that Prof. Morgan's treatment of his subject had been such as to secure the unanimous vote that he had passed his trials *summa cum laude*. Prof. Morgan was then "capped" amid enthusiastic applause.

BY the will of the late Mr. H. Musgrave, of Belfast, who died on January 2, the sum of about 50,000*l*. has been bequeathed to Queen's University, Belfast, and 2000*l*. to the Royal Academical Institution, Belfast.

THE summer meeting of the Association of Science Teachers will be held at Oxford on Saturday, July 8. A business meeting will be held in the morning, and in the afternoon there will be a lecture by Mr. A. F. Walden, New College, Oxford.

IT is announced in the *Chemiker Zeitung* that Dr. Fr. Quincke, director of the Rhenania, Aachen, has been appointed professor of technical chemistry at the Technische Hochschule, Hanover, in place of Prof. Ost, who has retired; and Prof. Adolf Sieverts of Greifswald has become professor of chemistry at the University of Frankfort-on-Main.

THE new School of Public Health, which will be opened at Harvard University next September, is offering several fellowships of 1200 dollars each for the year 1922–23. Well-qualified students working for doctorates or wishing to do a definite piece of research will be given special consideration. Applications for these fellowships should reach the Secretary of the School of Public Health, 240 Longwood Avenue, Boston 17, Massachusetts, not later than August 1.

A FAR-REACHING scheme for industrial training was recently adopted by the Convocation of the University of London. Put shortly, the proposal is that the University should co-operate with the City Guilds and cognate bodies in the selection of Boards dealing with their respective trades, and that these Boards should seek, among the workers themselves, shrewd men and women of intelligence, skill, and *savoir faire* to deal with apprentices, learners, and improvers, bestowing upon them a kind of parental care and watching over their health, their progress, and their interests generally; that such trainers should find a place in every workshop and in every factory, and should receive recognition at the hands of the Guilds and of the University as a reward for the fostering care extended to their pupils; that the industrial classes are well able to supply such persons, men and women, in numbers sufficient to impress their mark upon the rising generation of workers, and that such might be designated University *teachers, trainers*, or *tutors* in their special trades, receiving a diploma to that effect, while, to apt and industrious pupils, the term University *pupil, scholar*, or *student* might be accessible with a corresponding diploma or certificate. In the report of the committee which accompanies the scheme, details of the various activities of the University are given under six main headings, and the thought arises, how can the Senate bear the proposed increased burden? Convocation itself seems well fitted to bear it. Its members, collected in suitable centres, would no doubt gladly assist in so meritorious a movement if the University should see fit to delegate the working out of the proposed scheme to a strong central committee (or delegacy), giving it powers to recognise local centres and to entrust them with branch work of benefit to the community. Such a delegacy might have its headquarters at the University centre, and the Clerk of Convocation could be its mouthpiece. It should report annually (at least) to Convocation, and through Convocation to the Senate, which might give it authority to speak in the name of the University on all matters relating to the scheme.

Calendar of Industrial Pioneers.

June 17, 1881. James Starley died.—The son of a Sussex farmer, Starley, in 1846, at the age of 15, became gardener to John Penn, the marine engineer. Afterwards he was employed by a London firm of machinists, and in 1857 he brought out the "European" sewing machine; subsequently he turned his attention to bicycles at Coventry. To his perseverance and energy Coventry owes its position as the centre of the cycle-making industry. A monument was erected to him there in 1884.

June 18, 1861. Eaton Hodgkinson died.—Known for his valuable contributions to the study of the strength of materials and for his discovery of the "permanent set" and of the position of the neutral axis in beams, Hodgkinson was born near Northwich in 1789. In Manchester he received lessons from Dalton, and while assisting his mother in business began the researches which led to his co-operation with Robert Stephenson and Fairbairn on their experiments in connection with the Britannia Bridge.

June 18, 1912. Floris Osmond died.—A distinguished French metallurgist, Osmond was trained at the École Centrale des Arts et Manufactures, and among other appointments he held was that of chief chemist at Schnieder's works at Creusot. Here he began his researches into the microscopical structures of iron and steel. He left Creusot in 1884, settled in Paris, and devoted himself to research, becoming the founder of the allotropic school in metallography.

June 19, 1898. Sir James Nicholas Douglass died.—For thirty years Douglass was engineer-in-chief to Trinity House, in which post he succeeded James Walker. The Wolf lighthouse was built under his supervision during 1862–69 at a cost of 63,000*l*.; he also designed the lighthouses on the Great Basses and Little Basses, strengthened the Bishop's Rock lighthouse, and during 1878–82 constructed the new lighthouse which replaced Smeaton's tower on the Eddystone.

June 19, 1915. Benjamin Franklin Isherwood died.—Born in New York City in October 1822, Isherwood was one of the first officers in the Engineer Corps of the United States Navy. He was a pioneer in carrying out scientific trials of steam-engines, and in 1859 published his "Engineering Precedents," a valuable work dealing with the friction losses and power of steam-engines. In 1861 he was raised to the position of engineer-in-chief of the Navy, a post he held till 1869. Recognised as the greatest marine engineer America has produced, he was for many years an honorary member of the American Society of Mechanical Engineers.

June 21, 1885. Henri Tresca died.—A student of the École Polytechnique, and for a time an engineer in the public service, Tresca was principal inspector of French exhibits at the Great Exhibition of 1851. Afterwards he became a professor of the Conservatoire des Arts et Métiers and served as president of the Société des Ingénieurs Civils. His labours were of the highest importance to the industrial arts of France, and included researches on the strength of materials, the efficiency of machines, the flow of metals, and the application of motive power.

June 22, 1876. Robert Napier died.—Commencing business in Glasgow as an engineer in 1815, with a capital of 50*l*. and a staff of two apprentices, Napier became one of the leading shipbuilders on the Clyde, and ultimately employed 3000 men. Of him Rankine said: "Few, if any, did more to bring marine architecture to the degree of perfection it has reached; and by drawing students of practical engineering from all quarters his building yard became a school of instruction to the world." E. C. S.

Societies and Academies.

LONDON.

Zoological Society, May 23.—Dr. A. Smith Woodward, vice-president, in the chair.—E. G. **Boulenger** and F. Martin **Duncan**: A cinematograph record of the life-history of the Axolotl (*Amblystoma tigrinum*).—H. N. **Hutchinson**: A model reconstruction of the marine reptile *Peloneustes philarchus*, a Pliosaur from the Oxford Clay.—Sir Sidney F. **Harmer**: On Commerson's dolphin and other species of Cephalorhynchus.—C. Forster **Cooper**: Miocene Proboscidia from Baluchistan.—R. I. **Pocock**: On the external characters of Scarturus and other jerboas compared with those of Zapus and Pedetes.

CAMBRIDGE.

Philosophical Society, May 15.—Mr. C. T. R. Wilson, vice-president, in the chair.—E. H. **Hankin**: An experimental investigation of soaring flight. If the loading (*i.e.* the weight lifted per square foot of wing area) of soaring animals is plotted against the span, a regular curve is obtained. The greater the span, the greater the loading. The flying-fish is a striking exception; the loading is more than eight times as much as it would be for a bird of similar size, and as the speed is at least equal to that of birds under similar conditions, the wings of flying-fishes are more than eight times as efficient as those of birds. A model of a fin-ray (×10) was made of wood and fixed, convex side forward, in front of the radiator of a motor. A manometer measured any pressure that might develop on the rear face of the fin-ray. When the air at the level of the fin-ray was "soarable," as shown by the behaviour of dragon-flies, a pressure of 6-10 mm. of water was obtained at the rear of the fin-ray when the motor was travelling at 30 m.p.h. Generally the pressure was greater at midday than at sunset, it was abolished by rain, and also if the fin-ray was so loosely fixed that it was thrown into vibration by the passage past it of the air. The shape of the ray was found to be of little importance—the only thing necessary being that there should be a sheltered area. Probably the whole wing of a bird might be so disposed as to give a sheltered area. Increase of the sheltered area also resulted in increase of speed. Entering into a descending current causes an increase of sheltered area, and the expected increase of speed has been observed with gulls, which indulge in true soaring flight (*i.e.* steep upward glides with the long axis of the bird inclined upward and pointed in the direction of travel) only when the bird is in a descending current of air. Inland soaring birds and dragon-flies show similar effects.—F. P. **White**: The projective generation of surfaces in space of four dimensions.—C. G. F. **James**: The analytical representation of the theory of congruences of conics.—Miss H. G. **Telling**: (*a*) The geometrical theory of the apolarity of quadric surfaces. (*b*) A set of fifteen quartic surfaces in space of four dimensions, and the application to the theory of cubic surfaces in ordinary space.—J. P. **Gabbatt**: The generalisation of the theory of the circles associated with a triangle by means of the theory of plane cubic curves.—B. M. **Wilson**: An asymptotic relation between two arithmetic sums.

PARIS.

Academy of Sciences, May 22.—M. Albin Haller in the chair.—The president announced the death of M. Laveran.—P. **Urbain** and G. **Urbain**: The extraction and purification of scandium from thorveitite of Madagascar. This mineral, which contains 42 per cent of scandium oxide, is fused with soda and the silica removed by washing. The residue, after dissolving in sulphuric acid, is treated with hydrofluoric acid, which precipitates scandium and rare earths as fluorides. The scandium is separated as acid sulphate after treating the fluorides with sulphuric acid, and further purified by conversion into the double sulphate of scandium and potassium.—J. **Costantin**: The Maltese cross shown by wood that has undergone traumatisms. An account of the methods of wounding the stems of chestnut, sycamore, and other plants for producing cross-like markings on sticks to be used as canes or umbrella sticks. A description is given of the changes produced by the wounds in the stem.—J. **Andrade**: Three classes of non-maintained vibratory movements.—S. **Sarantopoulos**: Positive increasing functions.—Th. **Varopoulos**: Some theorems of M. Borel.—R. **Nevanlinna**: The relations which exist between the order of growth of a monogenous function and the density of its zeros.—E. **Pagezy**: The best shape to give to propulsive helices.—P. **Fatou**: The movement of a planet in a resisting medium.—P. **Chofardet**: Observations of Skjellerup's comet made with the *coudé* equatorial at the Observatory of Besançon. Positions for May 19 and 20 are given. The comet was of about 12·5 magnitude, maximum size 1′, condensation uncertain.—A. **Schaumasse**: Observation of Skjellerup's comet made with the *coudé* equatorial at the Nice Observatory. Position given for May 19. The comet appeared as a diffuse nebulosity about 2′ in extent; magnitude 12, feeble condensation.—A. **Andant**: The variations of critical opalescence with the temperature and the wave-length of the incident light. Measurements were made on five liquids of high critical temperatures—ether and the acetates of methyl, ethyl, butyl, and isobutyl. The phenomena observed in the case of ether are described in detail.—E. **Bauer**: The electromagnetic field of the stationary projectories of Bohr.—A. **Frigon**: The experimental study of the energy losses in some commercial dielectrics.—E. **Berger**: The reduction of oxides by hydrogen. Previous results on the reduction of nickel oxide by the author and Sabatier and Espil have not been in agreement, and further experiments have now been carried out to study the effect on the reduction of the mode of preparation and drying of the nickel oxide. The velocity of reduction and form of the curve vary with the origin of the sample of oxide, hence the deduction of the existence of an intermediate oxide from a kink in the reduction curve is not sound.—A. **Damiens**: The "dynamic" allotropy of tellurium. Cöhen and Kröner have applied to tellurium a theory of allotropy termed "dynamic," according to which any homogeneous phase of a given body may be composed of several species of molecules in equilibrium. Experiments by the author on carefully purified tellurium, crystallised, fused, and distilled, do not confirm the views of Cohen and Kröner, and all the phenomena observed can be easily explained without the formulation of a new theory.—A. **Dauvillier**: The L series of lutecium and of ytterbium and the identification of celtium with the element of atomic number 72.—G. **Urbain**: The atomic numbers of neo-ytterbium, lutecium, and celtium. From the high-frequency spectra it is now possible to attribute without ambiguity the atomic numbers of neo-ytterbium (70), lutecium (71), and celtium (72). A translation of the paper appears on p. 781.—A. **Boutaric** and M. **Vuillaume**: The flocculation of colloidal sulphide of arsenic. The influence of the concentration of the colloid, of agitation, and of temperature. The experimental results are shown graphically in four curves.—MM. **Clément** and **Rivière**: Attempts at the synthetic manufacture of mother-of-pearl by the production of chemical systems.—A. A. **Guntz**: Phosphorescent zinc sulphide. The crystalline structure of sulphide of zinc appears to play an important part in the phenomena of phosphorescence, as shown by the different duration of the luminosity of the two varieties and by the known fact that their pulverisation suppresses almost entirely the luminous emission.—A. **Job** and R. **Reich**: An attempt at the systematic extension of the preparation of organo-metallic compounds. Application to iron ethyl iodide. Organo-zinc compounds possess the advantage over the corresponding magnesium compounds that a large range of solvents can be used. The iron derivative, C_2H_5FeI, is made by the interaction of an ether solution of ferrous iodide with zinc ethyl iodide also in ethereal solution. The new iron compound was not isolated, but its existence in the solution was proved by its reactions with water and alcohol.—M. **Flajolet**: The perturbations of the magnetic declination at Lyons during the year 1920–1921.—A. **Petit**: The harmful action of farmyard manure.—A. **Policard** and Mlle. J. **Tritchkovitch**: The direct fixation of fats by the sebaceous glands. The fat absorptions were followed by the addition of Soudan red (Daddi) to the food. The mechanism of the sebaceous glands appears to act in two waves. In the first, the classical theory, the fat is elaborated by the cell, but side by side with this there is a direct fixation of the fat brought by the blood.—P. **Portier** and M. **Duval**: The variation of the osmotic pressure of the blood of the freshwater teleostean fishes under the influence of the increased salinity of the surrounding water. The fish is incapable of maintaining a constant osmotic pressure like a mammal or a bird, but there is a clear tendency towards regulation in the carp, in which the osmotic pressure of the blood increases with an increase in the proportion of salts in the water in which it is placed.—H. **Cardot** and H. **Laugier**: The linguo-maxillary reflex.—G. **Bidou**: An orientation compass for the foot.—C. **Vaney** and J. **Pelosse**: Relations between the blood and the coloration of the cocoon in *Bombyx mori*.—E. **Fauré-Fremiet** and Mlle. H. **Garrault**: Constitution of the egg of the trout, *Trutta fario*.—A. **Helbronner** and W. **Rudolfs**: The attack of minerals by bacteria. The oxidation of blende. Certain bacteria are capable of converting blende into zinc sulphate: in minerals containing the sulphides of both zinc and lead, the lead is not attacked and only the zinc is rendered soluble.—L. **Fournier**, C. **Levaditi**, A. **Navarro-Martin**, and A. **Schwartz**: The preventive action in syphilis of the acetyl derivative of oxyaminophenylarsinic acid (sodium salt). Proofs of the prophylactic and preventive action of this salt against syphilis are given. The experiments were made both on animals and on man.

Official Publications Received.

Madras Fisheries Department. The Common Molluscs of South India. By James Hornell. (Report No. 6 of 1921. Madras Fisheries Bulletin, Vol. 14.) Pp. 97-215. (Madras: Government Press.) 1 rupee.

Agricultural Research Institute, Pusa. Bulletin No. 125: The Weevil Fauna of South India, with special reference to Species of Economic Importance. By T. V. Ramakrishna Ayyar. Pp. 21+20 plates. (Calcutta: Government Printing Office.) 1.4 rupees.

Agricultural Research Institute, Pusa. Bulletin No. 126: Cawnpore-American Cotton, II. Further Field Trials (1918–1920), Spinning Trials and Market Organization. By B. C. Burt. Pp. 13. (Calcutta: Government Printing Office.) 4 annas.

Agricultural Research Institute, Pusa. Bulletin No. 127: The Coconut-Bleeding Disease. By S. Sundararaman. Pp. 8+6 plates. (Calcutta: Government Printing Office.) 8 annas.

Department of the Interior: Canada. Publications of the Dominion Astrophysical Observatory, Victoria, B.C. Vol. 2, No. 1: The Radial Velocities of 594 Stars. By J. S. Plaskett and others. Pp. 127. (Ottawa: Government Printing Bureau.)

Department of Agriculture and Natural Resources: Weather Bureau. Annual Report of the Weather Bureau for the Year 1918. Part 3: Meteorological Observations made at the Secondary Stations during the Calendar Year 1918. Pp. 353. (Manila: Bureau of Printing.)

Diary of Societies.

FRIDAY, JUNE 16.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 8.—A. C. Braham: The Final Support in Carbon Printing.

TUESDAY, JUNE 20.

INSTITUTION OF GAS ENGINEERS (Annual General Meeting) (at Institution of Electrical Engineers), at 10 A.M. and 3.—T. Hardie: Presidential Address.—Gas Investigation Committee: Research on Aeration in Atmospheric Burners.—Seventh Report of the Gas Investigation Committee: Carburetted Water Gas Plant with Waste-heat Boiler.—Report of Institution Gas Research Fellowship: Dr. A. C. Monkhouse and Prof. J. W. Cobb: The Liberation of Nitrogen and Sulphur from Coal and Coke as Ammonia.—Report of the Life of Gas Meters Committee.—Report of Refractory Materials Research Committee.—A. T. Green: The Thermal Conductivity of Refractories at High Temperatures.—Miss D. A. Jones: The Standardisation of the After Contraction Test.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. Gordon Holmes: The Symptoms of Cerebellar Disease and their Interpretation (Croonian Lectures) (4).

ROYAL STATISTICAL SOCIETY, at 5.15.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—E. Peake: The Norwich School of Painters.

WEDNESDAY, JUNE 21.

INSTITUTION OF GAS ENGINEERS (at Institution of Electrical Engineers), at 10 A.M. and 3.—Dr. C. Carpenter: Some Gas Burners and a Moral.—Dr. G. Weyman: Increasing the Rate of Carbonisation of Coal.—W. B. Leech: Reconstruction Work at Beckton.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 5.—W. H. Bidlake: The Continuity of English Architecture.

ROYAL METEOROLOGICAL SOCIETY, at 5.—J. E. Clark, H. B. Adames, and A. D. Margery: Report on the Phenological Observations for 1921.—L. S. Richardson, Dr. A. Wagner, and R. Dietzius: An Observational Test of the Geostropic Approximation in the Stratosphere.

ROYAL MICROSCOPICAL SOCIETY, at 8.—A. Chaston Chapman: The Use of the Microscope in the Brewing Industry.—A. B. Klugh: The Plunger-Pipette.—E. A. Spaul: The Gametogenesis of *Nepa cinerea* (Water Scorpion).—J. Strachan: The Microscope in Paper Making.

THURSDAY, JUNE 22.

INSTITUTION OF GAS ENGINEERS (at Institution of Electrical Engineers), at 10 A.M.—Prof. C. V. Boys: A Recording and Integrating Gas Calorimeter.

ROYAL SOCIETY, at 4.30.—*Probable Papers.*—G. I. Taylor: The Motion of a Sphere in a Rotating Liquid.—Prof. T. R. Merton and D. N. Harrison: Errors arising in the Measurement of Unsymmetrical Spectrum Lines.—Dr. E. F. Armstrong and Dr. T. P. Hilditch: A Study of Catalytic Actions at Solid Surfaces. Part VIII. The Action of Sodium Carbonate in promoting the Hydrogenation of Phenol. Part IX. The Action of Copper in promoting the Activity of Nickel Catalyst.—E. A. Milne: Radiative Equilibrium: The Relation between the Spectral Energy Curve of a Star and the Law of Darkening of the Disc towards the Limb, with Special Reference to the Effects of Scattering and the Solar Spectrum.—C. W. Hinshelwood: The Structure and Chemical Activity of Copper Films and the Colour Changes accompanying their Oxidation.—R. C. Ray: Heat of Crystallisation of Quartz.

MALTHUSIAN LEAGUE (at Kensington Town Hall), at 8.—Miss Cicely Hamilton, Mrs. Seaton-Tiedeman, B. Dunlop, and Rev. G. Lang: Birth Control the Workers' Charter.

FRIDAY, JUNE 23.

PHYSICAL SOCIETY OF LONDON (at Imperial College of Science and Technology), at 5.—J. W. Fisher: An Experiment on Molecular Gyrostatic Action.—Prof. A. O. Rankine and C. J. Smith: The Viscous Properties and Molecular Dimensions of Silicane.—W. N. Bond: The Pressure-Gradient in Liquids flowing through Cones.—Dr. E. E. Fournier d'Albe: Demonstration of a Mercury-Drop Method of producing Visual Effects by Means of Sound.

PUBLIC LECTURES.

(*A number in brackets indicates the number of a lecture in a series.*)

TUESDAY, JUNE 20.

KING'S COLLEGE, at 5.30.—Miss Hilda D. Oakeley: The Idea of Value in the History of Philosophy (1).

WEDNESDAY, JUNE 21.

ROYAL SOCIETY OF MEDICINE, at 5.—Prof. A. A. Hijmans van den Bergh: The Pathology of Hæmoglobin. (In English.)