THURSDAY, JULY 19, 1906.

SOME RECENT MATHEMATICAL WORKS.

Correspondance d'Hermite et de Stieltjes. Edited by B. Baillaud and H. Bourget. Vol. ii. Pp. viii+404. (Paris: Gauthier-Villars, 1905.) Price 16 francs.

G. Lejeune Dirichlet's Vorlesungen über die Lehre von den einfachen und mehrfachen bestimmten Integralen. By G. Arendt. Pp. xxiv+476. (Brunswick: Friedrich Vieweg and Son, 1904.) Price 12 marks.

Le Calcul des Résidus et ses Applications à la Théorie des Fonctions. By Ernst Lindelöf. Pp. viii+144. (Paris: Gauthier-Villars, 1905.) Price 3.50 francs.

Les Principes des Mathématiques. By Louis Couturat. Pp. viii+342. (Paris: Félix Alcan, 1905.)

Méthodes de Calcul graphique. By Frederico Oom. Pp. 26; with 4 plates. (Lisbon: Imprimerie nationale, 1905.)

Volume and Surface Integrals used in Physics. By J. G. Leathem. Pp. 48. (Cambridge: University Press, 1905.) Price 2*s.* 6*d.* net.

Recherche sur les Champs de Force hydrodynamiques. By V. Bjerknes. Reprinted from *Acta Mathematica*, vol. xxx. Pp. 146.

Sur la Recherche des Solutions particulières des Systémes différentiels et sur les Mouvements stationnaires. By T. Levi Civita. Pp. 40. (Warsaw: J. Sikorskiego, 1906.)

ONE of the most noticeable features of recent times has been the increasing interest taken in the history of mathematics. That two international congresses—the historical and the mathematical—have devoted separate sections to this study is, let us hope, a stepping-stone towards the realisation of the resolutions passed at both congresses in favour of the establishment of chairs of mathematical history in the leading universities of the Continent and America, and possibly even Great Britain.

Reference has previously been made to the first volume of the interesting correspondence between Hermite and Stieltjes. The second volume, covering the period 1889–1894, is no less delightful reading than the first. Every letter fills up some gap in the reader's mathematical knowledge, either by introducing him to some little-known proposition or by presenting some well-known result in a new aspect. An appendix contains four letters addressed by Stieltjes to Prof. Mittag-Leffler in 1885–1887 dealing with Riemann's Zeta function. These letters afford a striking insight into the difficulties experienced by Stieltjes in his efforts to master Riemann's works and his ingenuity in devising alternative methods. The present volume contains a portrait of Hermite and the facsimile of a manuscript by Stieltjes.

The historic spirit has further shown itself in Prof. Arendt's issue of the nearest possible approach to a verbatim report of the lectures on definite integrals as given by Dirichlet at Berlin in 1854. It is true, as the author points out, that the lectures which Dirichlet gave on the same subject at Göttingen four years later formed the basis of the well-known treatise by Gustav Ferdinand Meyer, but it appears that the notes on which Meyer's account was based were far from complete, and it was necessary to spend considerable time in filling up the gaps in the reasoning, and, moreover, the object was to give a complete treatment of the subject rather than an exact account of the lectures. Prof. Arendt, on the other hand, has compiled the present work from a set of notes mostly transcribed on the actual dates of the lectures. The course covers a branch of mathematics well known to the average student, namely, the definition of an integral and its connection with summation, the theorems on change of limits and differentiation of integrals, the evaluation of the ordinary well-known definite integrals, the Beta and Gamma functions, transformation of multiple integrals, the attractions of ellipsoids, and applications to harmonic and hypergeometric series. The notes at the end afford evidence of the care with which the original manuscript has been followed; where any divergence has been necessary the changes are carefully pointed out; the only important innovation, however, is the introduction of the modern notation $[a]$, which greatly simplifies certain formulæ. At the present time these lectures of Dirichlet make an excellent text-book, and an interesting historical comparison may be made between the present course and Kronecker's lectures delivered at the same university about thirty years later.

Another prominent place among the "classics" must be assigned to Prof. Ernst Lindelöf's charming exposition of Cauchy's calculus of "residues." This is the eighth of a series of monographs on the theory of functions appearing under the editorship of Prof. Émile Borel. In Prof. Lindelöf, Cauchy's ideas have found an able exponent, and from a detailed study of a number of papers, including some of Cauchy's little-known writings lent for the purpose by Prof. Mittag-Leffler, the author has produced a treatise in which the simplicity and perfection of this important method of analysis are well shown. Of the applications, those in the second chapter are mainly due to Cauchy. The third shows how certain formulæ of summation can be immediately deduced from the same principle, while in the fourth it is shown how this method of treatment greatly simplifies the study of the Gamma function and of Riemann's function. Of the importance of the latter application the difficulties of Stieltjes already referred to give sufficient proof, and on the other hand the name of Stieltjes figures conspicuously in the discussion of Stirling's series, in connection with which Prof. Lindelöf contributes several new results and proofs. Finally we have a general account of certain modern results relating to functions defined by Taylor's series, thus bringing into one small volume a general survey of the recent as well as the original developments of Cauchy's method. The book includes new matter for which the author is himself responsible as regards methods of treatment no less than as regards results.

A second line of modern mathematical development consists in the attempt to probe ever deeper and deeper into the foundations of mathematics. In France,

where everything mathematical is as popular as it is unpopular in England, the philosophy of mathematics has taken such hold of public thought that the multiplication of books on the subject has in a small way resembled the multiplication of school geometries with us. But a philosophical treatise stands on a very different level from a mere examination text-book, and if we have been somewhat severe in the past in our criticisms of the work of isolated writers in France, it was felt that what was wanted was something more than a number of isolated writings, each, from the nature of the case, presenting the views of one individual without much reference to the subject and its literature considered as a whole. The opening words of M. Couturat's preface, "The present book has no pretension to originality, and this is precisely what ought to recommend it to the reader," show that the author has been at great pains to fill the want. His book is to a large extent based on Mr. Bertrand Russell's English treatise with the same title, and is intended to provide a *résumé* of our present knowledge on the philosophy of mathematics. It is somewhat remarkable that up to the middle of last century logic and mathematics were regarded as essentially distinct, and it was largely the result of the labours of Boole, Peano, Cantor, and others that led to the gap being filled and to the opening out of what has proved to be one of the most fertile regions of modern thought. The complete rapprochement owes its existence very largely to the symbolical logic or "logistic" of Peano, and leads to the conclusion that mathematics is entirely and exclusively founded on the principles of logic. This view is, as M. Couturat shows, diametrically opposed to the philosophy of Kant of which a summary has been given in the appendix. It need hardly be said that Russell's treatment is in many places closely followed, and it is the author's hope that the book will induce French writers to contribute to our knowledge of mathematical philosophy in a way that has not been done hitherto.

A perusal of Mr. Oom's pamphlet will convince any reader that however much has been done elsewhere in facilitating calculations by the introduction of graphical methods, the observatory of Lisbon under the directorship of Vice-Admiral Campos Rodrigues has made a number of very distinct advances. For the correction of level and deviation error diagrams are used, as also for the corrections due to precession, and a still happier thought is the construction of slide rules for the performance of addition operations other than the addition of logarithms performed by the ordinary slide rule. Thus, for example, a slide rule graduated in reciprocals is used to work out relations between the conjugate foci of a lens; another, graduated in squares, is applicable to quantities connected by the relation between the sides of a right-angled triangle, and is particularly useful for calculations of probable error, and so on. Possibly some reader of NATURE will write and say that these slide rules have been in existence previously. In any case they are worthy of note, and M. Rodrigues appears to have devised them "off his own bat."

The issue of a series of "Cambridge Tracts in Mathematics and Mathematical Physics" under the able editorship of Messrs. Leathem and Whittaker affords evidence of the activity of the younger generation of Cambridge mathematicians. The idea is a good one. Many people have ideas about the best methods of treating some particular piece of work, which do not cover a sufficiently wide range to form a book, and are unsuitable for publishing and possibly burying in a volume of transactions. So much is this the case that we should not be surprised if Mr. Leathem finds himself besieged by tracts submitted for publication. His own contribution deals with an important point. Many physicists in the solution of problems have had to transform volume and surface integrals in a way that they either have known or ought to have known was not perfectly rigorous, but with the knowledge that the results would be all right; this particularly applies to integrals extending to infinity, and we have here in a convenient form a study of these transformations in their mathematical aspect. In discussing the application of infinitesimal analysis to potential properties of bodies of discontinuous structure, Mr. Leathem introduces the notion of *physical smallness*. The term is, perhaps, not altogether a happy one, as physics concerns itself not only with bodies of finite size, but with molecules which are of a higher order of smallness than the elements contemplated. The important point is that the applications of differential equations are based on the consideration of elements which for purposes of analysis may be regarded as infinitesimal, but which may be regarded, on the other hand, as infinitely great compared with the dimensions of molecular structure. It would be better to call such elements "differential elements" since they represent the $dx\ dy\ dz$ of the formulæ. The careful discussion of the legitimacy of the assumptions involved, as given by Mr. Leathem, is important, as we often find unscientific writers announcing as a great discovery the view that there is no such thing as temperature, quite forgetting that the notion of "temperature at a point" stands on much the same footing as that of "density at a point" or, indeed, many other similar concepts without which the study of mathematical physics would not have made the progress that it has made.

The series of papers and books by C. A. Bjerknes the father and V. Bjerknes the son well illustrate the proper spirit of scientific inquiry as opposed to the spirit of the unscientific faddist whose rejected addresses give so much trouble to reviewers. The discussion of the fields produced by bodies moving in fluids, if it has not given us a new theory of matter has certainly greatly helped us to understand the lines on which such theories should be laid down. The elder Bjerknes confined his attention to solid spheres moving in liquid; in the present instance, "bodies" are represented by portions of fluid differing from the remainder by the fact that in the latter the equations take a simple form. But is not this merely the vortex atom theory? It is true that on pp. 134–7 Prof. Bjerknes compares his results with those of von Helmholtz and Lord Kelvin, and points out the differences in his method of treatment, but all these investigations are

only different developments of the same fundamental ideas.

In recent years, Prof. Levi Civita has published a number of papers in the *Atti dei Lincei* dealing with particular solutions of the equations of dynamics, and in especial with stationary motions. At the invitation of Prof. Dickstein he has now prepared a simplified account of these researches for the transactions of the "Prac matematyczno fizyczynych," published at Warsaw. The original starting point of the investigation was the method of ignoration of coordinates, but the conclusions have now been shown to be results of a general principle applicable to any system of ordinary differential equations. They form a development of the work of Routh, and the stationary motions investigated by the author of "Rigid Dynamics" are shown to belong to a particular class to which Prof. Levi Civita gives the name of "mouvements à la Routh." G. H. B.

A TREATISE ON CHEMISTRY.

A Treatise on Chemistry. By Sir H. E. Roscoe, F.R.S., and C. Schorlemmer, F.R.S. Vol. i. The Non-Metallic Elements. New edition, completely revised by Sir H. E. Roscoe. Pp. xii+931. (London: Macmillan and Co., Ltd., 1905.) Price 21*s.* net.

SIR HENRY ROSCOE is to be heartily congratulated by all chemists on the appearance of a new edition of the first volume of Roscoe and Schorlemmer's "Treatise on Chemistry." This volume deals chiefly with the non-metallic elements, and is now in its third edition.

Many chemists remember the interest which the first appearance of this volume excited in 1877. Printed in large, clear type, with excellent illustrations, it was recognised both here and on the Continent as a clear and readable account of the facts relating to the chemistry of the non-metallic elements. If the student failed to find in it any new light on the obscurities of chemical theory, he at any rate was put in possession, not merely of the facts, but of the facts stated with a due regard for the history of their discovery which was then and is still foreign to the ordinary "handbook." There were, moreover, many experimental details of service to workers in the laboratory recorded in the volume which were at that time not easily accessible to the ordinary student. During the nearly thirty years which have elapsed since the first edition appeared, many treatises have been published in other languages, notably in German, but the treatise of Roscoe and Schorlemmer still retains a certain individuality for which it will be valued.

In preparing this edition Sir Henry Roscoe has had the valuable assistance of several collaborators with special knowledge, and their handiwork is to some extent evident in the different literary treatment which may be discerned in various sections of the book.

The first section of the volume relates to the general principles of the science, including a description of the properties of gases and liquids, and a very intelligible account of the development of the atomic theory. A clear sketch is given of the theory of electrolytic dissociation. This portion of the volume would have been improved by some concrete illustrations of the methods of determining atomic weights. As it is, the reader must be very much at sea in understanding what this constant actually means, apart from the implications of the atomic theory.

The remainder of the book is occupied with an account of the properties and modes of preparation of each of the non-metallic elements and their chief compounds. The history of each element is succinctly and well described, and important industrial applications are also alluded to. There is an excellent account of the modern manufacture of illuminating gas and of acetylene, as well as of the commercial processes adopted for the production of a number of the elements and their compounds which find industrial uses.

There is also a very complete account of the preparation and properties of the new gases of the atmosphere, argon, &c., which, while interesting, does not throw any new light on the obscure chemical relationships of these elements. In this connection the absence of an account of the periodic classification under the general principles of the science is specially felt. It would have been better to have included in the first part of this volume a complete consideration of the general principles of chemistry, including the determination of atomic weights, instead of reserving the discussion of the periodic classification and other matters of principle for the subsequent volume relating to the metals.

When the first edition of this volume appeared, many of the lecture experiments described were new, and were of interest and value to the teacher. A number of these are now generally familiar, whilst some of those still described have since been improved upon. This feature is indeed no longer a striking one in the book. Very few new lecture or laboratory experiments are included. The teaching of chemistry is, however, no longer conducted on the old lines, and perhaps the teacher would not now look to a treatise of this kind for this information. The fact that in some sections of the work pains are taken to describe fully striking lecture experiments whilst in other and newer sections this aspect is entirely neglected is a defect in the general plan of the book which might be remedied in future editions.

This raises the question as to the characters which such a work as this should possess to be of real utility at the present day. Handbooks and text-books of chemistry for the teacher abound, many of them excellent as practical guides to the work of the lecture room and laboratory. Then there are more ambitious works purporting to be of the nature of treatises. These, however, are too often ill-assorted and ill-considered collections of the facts and theories of chemistry utterly lacking in those literary qualities without which no work of the kind can expect to appeal to the general reader or to take any permanent place in the literature of the science. There is still room for a treatise in the broad sense of the word, in which the facts and doctrines of modern chemistry are expounded in a lucid manner free from the details and technicalities which are essential in a handbook or

text-book. Such a work should appeal to the teacher and to the student as a work of reference, and also to the outsider, it may be a worker in another department of science, who wishes to understand what the science of chemistry now is without being confronted with all the bewildering and conflicting details of the subject, such as the advanced student may find in Watts's Dictionary or in many German works on chemistry.

Such a treatise, perfect as a broad and general description and discussion of the science of chemistry, has not yet been written in English. Roscoe and Schorlemmer's treatise, however, still remains the nearest approach to the ideal.

POPULAR EVOLUTIONARY THEORY.

Darwinism and the Problems of Life; a Study of Familiar Animal Life. By Prof. Conrad Guenther. Translated by Joseph McCabe. Pp. 436. (London: A. Owen and Co., 1906.) Price 12*s.* 6*d.* net.

THIS is a disappointing book. The idea of using the common sights and sounds of nature which are open to general observation as material for building up a detailed comprehension of evolutionary theory is a good one; there is much to be said for the inductive system of instruction as a supplement to the deductive methods more often employed. But in this particular instance the errors in matters of fact are so prominent and so numerous as to overshadow such merit as the plan of the work possesses. Some of these mistakes must be laid to the charge of the translator, who obviously is but imperfectly acquainted with the subject-matter of his original, and whose want of due care appears in the occurrence of such phrases as "the grouping of their elements is different from in dead albumen," "Pentastomum has little of the characteristics of a spider, to which it really belongs," and of such unwonted forms as "terrestial," "adaption," "caracoid," "strepsitera"—the last two being found more than once. "Sexually," on p. 301, is clearly intended for "non-sexually." "An example of a genius under the generic title" is capable of easy emendation, but "weel" (p. 220) almost baffles conjecture. Can it be meant for "valve"?

The "processionary butterfly" is, of course, a moth; the "tentacles" of the stag-beetle (p. 91) are apparently its mandibles; we hear for the first time of the "bones" of articulates, and that our muscles are "secretory products." It is implied on p. 143 that the adder is not poisonous. This is surprising until we find from other passages that the author's "adder" is not an adder at all, but the harmless ringed snake. A sentence on p. 226 is absolutely unintelligible, unless we may conjecture that the word "falls" is an attempt to render the German "Fälle," here obviously used in the sense of "cases."

It is charitable to the author to suppose that not he but his translator is responsible for the statement that "in the case of moths and grasshoppers there is not a very great difference in habits between the larva and the imago." But when we find it stated that "in the grasshoppers the front extremities have become a powerful leaping apparatus"; that an insect is covered with "dust" by the "stigma" of a flower; that "if we take two beetles that seem absolutely like each other and only differ in size" they are of different species; that "the frogs have only one chamber to the heart"; and that "iron is always found combined with sulphur," it is difficult to avoid the conclusion that the author has to answer for mistakes of his own.

There are advantages in using the popular names of natural objects in a book intended mainly for the unlearned. But a protest must be entered against the slovenly habit, too common with translators, of contenting themselves with a literal rendering of such names into another language. How, for example, is the English reader to identify the "small nocturnal peacock's eye"? If the scientific name be disallowed, at least the recognised English popular title should be given.

Many of the author's conclusions on the main subject are sound enough. It is the more to be regretted that his statements of fact are so often open to adverse criticism, and that he has been, on the whole, so badly served by his translator. F. A. D.

OUR BOOK SHELF.

Aufnahme und Analyse von Wechselstromkurven. By Dr. Ernst Orlich. Pp. viii+117. (Brunswick: F. Vieweg and Son, 1906.) Price 3.50 marks.

IN the usual handbooks on alternating currents the methods of study of the wave-form of the alternations and the analysis of the curves of E.M.F. and current obtained are usually treated very scantily. Recently, however, the subject has attracted considerable attention, and its importance to a station engineer, who wishes to make alternators not identical in design run well in parallel, is now recognised.

Prof. Orlich, of the Reichsanstalt, has endeavoured in this little book to present a clear account of what is known on the subject. It begins by definitions and a short mathematical introduction to the use of Fourier series, &c. Then follow descriptions of various methods of taking curves by the point-to-point process, and of the apparatus of Rosa, of Callendar, and of Hospitalier's "Ondographe."

The Braun tube is described and illustrated, but no mention is made of the fact that owing to the kathode-ray bundle not being composed of rays of the same magnetic deflectability, and the consequent lack of sharpness of the moving image, its use for the study of alternating currents is limited rather to qualitative than to quantitative work. The next chapter deals with oscillographs in their various forms. Their theory is discussed, and the advantages of the different patterns of moving needle and bifilar instruments pointed out.

The recent experiments on telephony of Mr. Duddell, and the wonderful curves shown by him at his recent lecture at the Royal Institution on the analysis and transmission of sounds, show that substantial advances have recently been made in the construction of very sensitive oscillographs of his pattern, the curves of currents furnished by an ordinary microphone being readily shown to a large audience.

After a chapter on the phenomena of resonance, the concluding portion of the book deals with the analysis of curves, with descriptions of the best-known forms

of harmonic analysers, including those of Henrici, and the machine devised by Michelson and Stratton for their analysis of visibility curves of interference fringes.

The information given in the book seems, on the whole, fairly complete and accurate. The word "periode" seems used in a loose sense, sometimes as "time of a single oscillation" and sometimes as "frequency." J. A. HARKER.

Cultures du Midi de l'Algérie et de la Tunisie. By C. Rivière and H. Lecq. Pp. xii+511. (Paris: J. B. Baillière et Fils, 1906.) Price 5 francs.

IN view of the fact that inside the British Empire agriculture is being practised under all sorts of tropical and semi-tropical conditions, there is a singular paucity of books in the English language dealing with the cultivation of exotic plants. The book before us, one of the "Encyclopédie agricole" series, reviews briefly the whole range of plants which are cultivated economically in the Mediterranean region belonging to France, *i.e.* in Provence, Algeria, and Tunis. This is a very special district possessing a characteristic flora adapted to its well-marked climatic conditions of insufficient rainfall which falls mainly in the winter, great heat and dryness in the summer, excessive radiation resulting in extreme variations of temperature, with sharp frosts in the winter, incessant wind, and an all-pervading sun. Under these conditions many forms of agriculture are only possible where irrigation water is obtainable, and much of the country is little better than bare rock or sand; there are, however, many important cultures, special to the district, which have been brought to a high state of perfection by the inhabitants of the Côte d'Azur.

The most distinctive example is perhaps the growth of plants for scent and essences which has its centre at Grasse, but which has been extended into both Algeria and Tunis; the rose, the orange-flower, the tuber rose, the violet, and the jasmine being the most important of the flowers thus cultivated. The olive, that most distinctive feature of all Mediterranean landscapes, is losing ground, we learn, being displaced by the competition of oils like cotton-seed and sesame; in Provence, also, the land is wanted for more intensive forms of cultivation, such as the production of early vegetables and cut flowers.

The book of MM. Rivière and Lecq suffers somewhat from the very extensive ground it has to cover; the accounts of each plant in cultivation have to be so curtailed that the details are insufficient for the needs of the practical man, who will, however, find an excellent series of references to more special books and articles on each subject. The book may be of considerable service to many of our colonists living in semi-arid countries and looking round for suitable and remunerative crops to grow; from it they can obtain both ideas as to possible introductions and such economic information as to the labour required and the probable value of the returns as may enable them to embark on the experiment with some prospect of success.

Tabulae Botanicae. (Part i., containing plates i. and ii.) Edited by E. Baur and E. Jahn. (Berlin: Gebrüder Borntraeger, n.d.) Price per plate: paper, 7 marks; cloth, 10 marks. Series of five, 25 marks.

UNDER this title the publishers announce a series of coloured illustrations of plants intended for lecture purposes, and arranged in sets for each subject, order, or class. The two diagrams received illustrate the Myxobacteriaceæ, the one representing successive stages in the life-history of *Polyangium fuscum*, selected as a general type, the other depicting the fructification, spores, &c., of Myxococcus and Chondromyces as special details. So far as one can judge from these specimens, the drawing entrusted to Ehrlich, of Berlin, promises to combine correct representation and artistic treatment, and the publisher's name is sufficient guarantee for good reproduction; the paper selected is not strong enough to withstand wear and tear, but at a somewhat higher price the plates may be obtained backed with linen and attached to rollers. The size of the diagrams, about 5 feet by 3 feet, is sufficiently large for most practical purposes. The short prospectus prefixed to the accompanying text provides little information, except to say that the plates will be designed two, three, or more to each subject, that the series will cover the whole field of the anatomy and the life-histories of plants, and that the lower plants will receive especially full treatment.

Reports of the Expedition to the Congo, 1903–5. Liverpool School of Tropical Medicine, Memoir xviii. Pp. 74. (London: Williams and Norgate.) Price 7*s.* 6*d.* net.

IN this report, the late Mr. Dutton and Dr. Todd contribute an important paper on gland-palpation in human trypanosomiasis, in which they show that most early cases of trypanosomiasis have enlarged glands, and can therefore be detected by gland-palpation. A second paper by the same authors discusses the distribution and spread of sleeping sickness in the Congo Free State. This is illustrated by four maps, which demonstrate very clearly the enormous extent of territory in which this terrible disease is now met with compared with twenty years ago. This is in great measure accounted for by the increase in travel following the opening up of the country. Two new Dermanyssid Acarids from monkeys' lungs are described by Mr. Newstead and Dr. Todd, and Dr. Stephens and Mr. Newstead contribute a paper on the anatomy of the proboscis of biting flies. It will thus be seen that the report contains matter of considerable interest, and the general "get up" leaves nothing to be desired.

Ten Years' Record of the Treatment of Cancer without Operation. By Dr. Robert Bell. Pp. 107. (London: Dean and Son, Ltd., 1906.) Price 2*s.* 6*d.* net.

IT is difficult to understand the *raison d'être* of this book, which consists mainly of a diatribe against the modern surgical treatment of cancer, and a veiled recommendation of the author's method of treatment by medicinal and hygienic measures. As regards any "record" of ten years' treatment by the author's methods we find little evidence—"several cases" eventually got quite well (p. 42), a case "recovered completely" (p. 43), a case in which "the tumour quite disappeared" (p. 63), three cases in which "recovery was complete" (p. 71). This constitutes the "record"; can the author be surprised if his views and methods be received with scepticism?

R. T. H.

The Opal Sea. By John C. Van Dyke. Pp. xvi+262. (London: T: Werner Laurie, 1906.) Price 6*s.* net.

PROF. VAN DYKE provides in these pages a readable account of many branches of modern oceanography expressed in a literary form too seldom found in works dealing with scientific subjects. As one would expect, the romance and poetry of science are given great prominence, and the attractive word-pictures reveal the fascinating nature of the work of the man of science. Many readers of these essays will be encouraged to undertake a more precise study of the physical geography of the sea from formal treatises.

LETTERS TO THE EDITOR.

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

The Stability of Submarines.

SIR WILLIAM WHITE, in his paper in the Roy. Soc. Proceedings (vol. lxxvii. A., p. 528), discusses the hydrostatic forces tending to stability or instability of a submarine at the surface of the water. When the vessel is in motion, hydrodynamical forces come into play from the stream-line action of the water, and these also will affect the stability of the vessel. Sir W. White insists that these forces can only be examined experimentally, and has no data to give as to their magnitude. Although it is obviously impossible to obtain an exact calculation of the magnitude of these hydrodynamical forces, yet it may be worth noticing that a very simple calculation will give an approximation to their value, which at least is of importance in that it suggests that the question is one of extreme gravity.

The principle involved is, of course, the well-known principle by which an ellipsoid moving through still water tends to turn so that its smallest axis is in the direction of motion.

We may obtain a first approximation to the stream-line action by treating the submarine as a cigar-shaped spheroid, and assuming it to be completely immersed in an infinite ocean. Let a, b denote the semi-axes of the spheroid, and let it be moving with velocity V, its major axis making a small angle θ with the horizontal. The couple tending to decrease θ is known to be

$$\tfrac{1}{2}V^2 \sin 2\theta \left(\frac{\alpha}{2-\alpha} - \frac{\beta}{2-\beta}\right)D,$$

where

$$\alpha = -2ab^2\left\{\frac{1}{(a^2-b^2)^{\frac{3}{2}}}\log\frac{a-\sqrt{a^2-b^2}}{b} + \frac{1}{a(a^2-b^2)}\right\},$$

$$\beta = ab^2\left\{\frac{1}{(a^2-b^2)^{\frac{3}{2}}}\log\frac{a-\sqrt{a^2-b^2}}{b} + \frac{a}{b^2(a^2-b^2)}\right\},$$

and D is the displacement of the vessel.

The figures given by Sir William White for an actual submarine are—length 150 feet, breadth 12·2 feet. If we take $a/b = 12{\cdot}3$ in our spheroid, we obtain

$$\frac{\alpha}{2-\alpha} - \frac{\beta}{2-\beta} = -0{\cdot}95.$$

Thus, for a displacement through a small angle θ from the horizontal, the stream-line couple produced by a velocity V through the water is

$$0{\cdot}95\,V^2\,D\theta,$$

tending to turn the vessel further from the horizontal.

If h is the metacentric height for longitudinal displacement, the hydrostatic righting couple is

$$gh\mathrm{D}\theta.$$

Thus the effective righting couple is

$$g\mathrm{D}\theta\left\{h - \frac{0{\cdot}95V^2}{g}\right\},$$

so that the metacentric height is diminished by the motion of the submarine by an amount $0{\cdot}95\,V^2/g$. This factor does not appear to depend much on the shape of the submarine; clearly, if its shape had been that of a thin long stick, we should merely have to replace 0·95 by 1·00, whereas if the ratio a/b had had only half of its present value, the numerical factor would still be about 0·9.

Sir William White gives as the metacentric height of an actual submarine 37 feet when awash on an even keel, and only 45 per cent. of this, say 16½ feet, when trimmed to an angle of 4 degrees. The value of V^2/g when V = 10 knots, is about 9½ feet, so that the effective metacentric height would be reduced to about 28 feet on an even keel, and to 7½ feet when trimmed 4 degrees by the stern. So far as can be judged from a diagram given by Sir William White (Fig. 7 in his paper), the metacentric height would vanish altogether for a trim of about 7 degrees.

Thus a submarine moving ahead at 10 knots, even under perfect conditions, might apparently be expected to founder if its inclination at any time reached as much as 7 degrees.

Sir William White mentions that in the case of the submarine A8, the hydrostatic metacentric height had been reduced, at the time the accident occurred, to 8½ feet. The further diminution in this height produced by a headway of 8 knots is about 6 feet—by a headway of 9 knots is about 7½ feet, leaving only about 1 foot of effective metacentric height as the margin of safety.

Obviously these rough calculations ignore a great number of factors which ought to be taken into account before accurate knowledge can be obtained. The most important of these factors is probably the proximity of the surface and the consequent formation of surface-waves. A calculation which omits a factor of this kind cannot lay claim to any value as advancing exact knowledge, but may serve the humbler purpose of suggesting possible, and even probable, dangers, and of emphasising the need for experimental knowledge, before this is forced on us by a catastrophe.

J. H. JEANS.

Trinity College, Cambridge.

THE mathematical investigation which Mr. Jeans puts forward is of great interest, but avowedly rests on the assumption of the complete immersion of a submarine in an infinite ocean. The concluding paragraph of his letter indicates that a great number of factors, which ought to be taken into account, are not represented in the mathematical investigation, the most important being near proximity to the surface and the consequent formation of surface-waves. It will suffice, therefore, for me to say that my insistence on the necessity for direct experiment, rather than mathematical investigation, had relation to the case where the submarine was moving at the surface with a small reserve of buoyancy. The slides which I exhibited at the Royal Society reproduced photographs taken in these circumstances, and showed the singular and irregular character of the surface-waves produced by the headway of submarines under these conditions. These slides furnished conclusive evidence of the impossibility of representing the conditions of practice by purely mathematical investigation, and the absolute necessity for experiments on models and full-sized submarines.

Mr. Jeans's investigation for the completely submerged vessel has, however, a great practical value, because it furnishes fresh and important reasons (in addition to those urged by myself) against the tendency to increase the under-water speeds of submarines. When submerged, the measure of stability of the vessel for all directions of inclination is found in the height of the centre of buoyancy above the centre of gravity. We are informed authoritatively that in the diving condition this height is less than 1 foot in existing types of submarines. It will be seen, therefore, that a very small value of V—less than 6 knots—might render such a vessel unstable; if the speed were increased to 10 knots no possible use of water-ballast could give such a hydrostatic stability to the vessel when at rest as would secure the maintenance of stability when she moved at full speed. The existence of superstructures on the upper portions of submarines, of course, involves a departure from the cigar-shaped spheroidal form, but cannot be accompanied by any such decrease in the moment of the couple resulting from the stream-line forces as would secure, or even add sensibly to, the safety of the submarine moving at high speed under water.

W. H. WHITE.

The Action of "α" Radiation on Diamonds.

THE action of the "α rays" on diamonds is of considerable interest, for while the fluorescence caused by the β and γ radiation from radium is probably similar to that caused by the X-rays, the appearance of a diamond made luminous by the impact of a stream of "α" particles suggests some considerations as to the possible action of "α" radiation on fluorescent crystals in general. The fluorescence of a fairly large stone (cut and polished) when viewed with a suitable lens shows practically nothing of the spinthariscopic action, although the stone may be brightly luminous. Instead of the familiar scintillations, the whole crystal, or at least the whole surface exposed to the rays, appears to give out a steady bluish-white light.

The thought at once occurs to one that this seemingly continuous flow may be the collective effect of the very numerous scintillations produced by a too intense stream of "α" rays; such an action is well shown on a zinc sulphide screen when there is an excessive quantity of radium used. That this action is really the collective fluorescence of scintillations is at once evident by removing the fragment of radium to a greater distance, reducing the quantity used, or increasing the magnifying power employed to view the screen. In the case of a diamond, however, this does not appear to be so. The use of a higher power to view the fluorescence still shows a seemingly steady glow, and the increase of the distance between the radium and the stone merely causes the light to become gradually fainter, while still preserving its steady character. Yet it is certain that the diamond responds readily to the "α" particles, and also that, as the quantity of radium is so very small, the action of the β and γ radiation is quite negligible. It is, of course, well known that when an "α" particle strikes a fluorescent screen, the point of impact becomes the centre of a luminous area, which is simply enormous in extent when compared with the size of the atomic projectile which causes it.

The following may perhaps be suggested as a possible explanation of this action:—When an "α" particle strikes a homogeneous fluorescent crystal (say a diamond), the energy which excites the fluorescence finds equal conduction in all directions. The fluorescence caused thus tends to fill the whole volume of the crystal. If there are many such atomic projectiles incident on the same crystal, they are all tending to do the same thing, and consequently their spheres of influence mingle with one another. As such spheres of fluorescence find equal conduction of all sides, they extend indefinitely within the limits of the crystal in question. As fluorescence is apparently a molecular property, and probably electrical in its nature, it is not difficult to imagine that such may be the case. A still pond, into which a handful of gravel is scattered, may present an approximate analogy. The ring-waves (neglecting the time they take to travel) would mingle with one another, and yet each one might be said separately to occupy the whole area of the pond. In the case of a zinc sulphide screen, or one coated with minute fragments of diamond crystals, the energy received by one crystal or fragment of a crystal is confined exclusively to the volume of that fragment. Moreover, it is impossible for an "α" particle to strike more than one crystalline fragment at a time, for it is a body of atomic dimensions compared with which the most minute fragment of the fluorescent compound would be enormous.

The whole of the available energy is thus confined to the limits of the fragment struck, and is not, apparently, extended to the neighbouring crystals, which are only in loose and indifferent contact with it. When such a crystalline fragment is of a size which is comfortably visible with the aid of a lens magnifying about 20 diameters to 30 diameters, the resulting fluorescence will be visible as a scintillation. To diminish the size of the crystals beyond a certain point in order to increase the brightness of the scintillations is apparently not advantageous, as it requires the higher powers of a compound microscope to render the areas properly visible, and there would be a corresponding loss of light.

On the analogy of the pond given above, the spinthariscopic effect may be compared to throwing a handful of gravel into a collection of small puddles. The disturbance caused in each would be strictly confined to its own area, and would be correspondingly intense within that area. With a given stream of "α" radiation, a small stone appears to give a very slight scintillating effect which is not seen in a larger stone, except at the edges and angles of the facets, where the area of fluorescence is abruptly terminated, and even here it is very faint. The above remarks would, of course, only apply to perfect crystals. If a crystal is full of flaws and imperfections, the areas or spheres of fluorescence would not find easy conduction across the faults, and would therefore become localised in their action. It may be noted that a lump of willemite (natural), which is of a semi-crystalline character, does show scintillations, though very imperfectly, while the powdered mineral answers much better. This may be explained on the assumption that the areas of conduction are restricted to the size of the particles. C. W. R.

June 20.

The Day of Week for any Date.

THE following method for finding the day of the week for any given date (new or Gregorian style) may interest your readers. We assign a number for each month in accordance with the *old* style, beginning with March, so that the last four months are numbered according to their Latin names, as follows:—

January, 0; February or March, 1; April, 2; May, 3; June, 4; July, 5; August, 6; September, 7; October, 8; November, 9; December, 10; next January, 11; next February, 12.

For a Leap Year, January and February must count as 11 and 12 respectively in the *preceding* year.

It is only in dealing with the month-number that anything not straightforward and obvious is involved.

The rule then runs as follows:—

A. For the *century*: divide by 4, and calculate 5 *times the remainder.*

B. For the *year*: add *to the number the quotient obtained from divisor* 4.

C. For the *month*: multiply by 4, and *negate the units digit* (*i.e.* subtract instead of adding it).

D. For the *day*: retain the number unchanged.

Then add together the results A, B, C, D (casting out *sevens*, of course, as you proceed), and the result gives the required day of the week.

The rule holds without modification, not excepting such years as 1600, 2000, &c., as well as 1700, 1800, 1900, &c.

Examples.—1906, September 19.

A. For *century*: 3×5=15 ... ... ≡1
B. For *year*: 06+1=7 ... ... ≡0
C. For *month*: 4×7 gives 20−8=12 ... ... ≡5
D. For *day*: 19 ... ... ≡5

A+B+C+D=11≡4, *i.e. Wednesday.*

1815, June 18 (Battle of Waterloo).

A. For *century*: 2×5=10 ... ... ≡3
B. For *year*: 15+3=18 ... ... ≡4
C. For *month*: 4×4 gives 10−6= 4 ... ... ≡4
D. For *day*: 18 ... ... ≡4

A+B+C+D=15≡1, *i.e. Sunday.*

1784,* January 12 (Pitt's appearance as Prime Minister).

A. For *century*: 1×5=5 ... ... ≡5
B. For *year*: 83*+20=103 ... ... ≡5
C. For *month*: 11*×4 gives 40−4=36 ... ... ≡1
D. For *day*: 12 ... ≡5

* Leap year.

A+B+C+D=16≡2, *i.e. Monday.*

W. E. JOHNSON.

King's College, Cambridge, July 11.

SOME SCIENTIFIC CENTRES.

VIII.—THE MACDONALD PHYSICS BUILDING, MCGILL UNIVERSITY, MONTREAL.

WISE liberality has rarely reaped a richer and more immediate harvest than the gift by Sir William Macdonald of the Physics Building to McGill University at Montreal. This benefaction is but one instance—though a very important instance—of the fact that education, particularly scientific and technical education, is of enormous practical advantage, and that the most wealthy men in Canada and the United States recognise that it has the first claim on their generosity. In England money is given with no less lavish hand, but vast sums are devoted to objects less deserving than education, inasmuch as they afford palliatives, and not preventives, of failure, suffering, or distress.

The Physics Building, with its accompanying endowments and equipment both for instruction and research, forms but a small fraction of the total gifts of Sir William Macdonald to McGill University—gifts which exceed in value three and a half million dollars. A brief history of its growth, more particularly as a centre of research work, may be of service to those desirous of emulating a noble example.

In 1891 a chair of physics was endowed by Sir William Macdonald, to which John Cox, formerly Fellow of Trinity College, Cambridge, was appointed as the first professor. He was at once instructed to visit the best laboratories in America, and thus add to his experience of similar institutions in Europe. He received the most cordial assistance in the United States, and learnt both what to acquire and what to avoid. On his return, in conjunction with the architect, Mr. Andrew T. Taylor, he planned a building, beautiful in appearance, and so complete in every detail, that it is scarcely possible, with an intimate knowledge of the internal arrangements, to suggest any material improvements. The general scheme was to provide a building which would meet the requirements of the ensuing fifty years. The cost of the fabric was 29,000*l.*, being at the rate of about elevenpence a cubic foot.

The donor further instructed Prof. Cox to prepare estimates for equipment and apparatus, and in response for a request of 5000*l.*, the sum of 6000*l.* was placed at his disposal. At this point Sir William Macdonald decided to endow another chair for research in physics, and the institution was fortunate in obtaining H. L. Callendar, from Trinity College, Cambridge, as its first occupant. The equipment of the laboratory continued from 1892 to 1897, when the founder was assured that sufficient apparatus had been obtained; but the first grant had been greatly exceeded, and the total donation for this purpose was 22,000*l.* This sum has been discreetly spent, and adequate provision has been made for lecture tables, laboratories, and for all branches of physical research. Sir William Macdonald made a further gift of 30,000*l.* in order to secure an annual income of 1500*l.* to provide for the salaries of demonstrators and to defray the cost of heat, light, upkeep of apparatus, and repairs to the fabric. As educational property is not subject to taxation in Canada, the only rate payable is the water tax. In addition to the preceding gifts, the donor of the Physics Building has made special grants from time to time for the purchase of radium, for a liquid-air plant, for two large induction coils, and in particular 1000*l.* for the purchase of books for the library in the building, and 400*l.* for a special research fund. It is fortunate that such splendid munificence has been judiciously expended by Prof. Cox, and that the results obtained have been such as to win for the laboratory a place in the foremost rank.

A detailed account of the rooms in the building is unnecessary, but an important item in the establishment is the workshop, with tools and lathes driven by electric motors, sufficient to make a large proportion of the more simple apparatus required for instruction or research. A complete plant of this nature, under a competent mechanic and assistant, effects a great saving of time and money in a city where skilled labour is often scarce and always costly. It is not within the scope of this article to give an account of the purely educational uses of this building, but it is sufficient to state that the lecture theatres and laboratories are ample in size and equipment, so that all students in the faculties of arts and of science receive courses in physics suited to the requirements of their future professions. An interesting question arises as to the extent to which professors of research should devote their time to the instruction of ordinary students. On the one hand, it may be regarded as a waste of valuable time, but from the student's point of view it is a great gain to come into contact, both in laboratory and lecture room, with the best intellects in his university. A research professor must necessarily devote some of his time to the instruction of advanced students, and particularly to the assistance of research students. It is therefore undesirable that any large

FIG. 1.—Macdonald Physics Building, McGill University, Montreal.

fraction of his time should be absorbed by giving lectures to elementary students. This difficult question of the division of time appears to have been satisfactorily solved in the Physics Building.

The first research professor, H. L. Callendar, was an active and able investigator. He invented and improved his platinum thermometer with an ingenious compensation method, and applied it to various uses. In conjunction with Prof. J. S. Nicholson, of the engineering building, he solved many temperature problems connected with the steam engine. He investigated some important meteorological questions, determining the temperature at various depths in the earth—a matter of special interest during the severe winters in Canada. He also constructed a self-recording instrument which measured the difference of temperatures between the top of Mount Royal and the base near the observatory. Further results have been obtained by Prof. C. H. McLeod and Dr. H. T. Barnes, using the same instrument. The latter was also associated with Prof. Callendar in effecting some improvements in the Clark cell as a standard of electromotive force. But Prof. Callendar's most important work at McGill was the development, in conjunction with Dr. Barnes, of the continuous flow method of calorimetry. This has proved a great advance, both for simplicity and accuracy, on the older methods of calorimetry. Very exact determinations have thus been made by Dr. Barnes of the mechanical equivalent of heat, and of the specific heat of water at various temperatures. Dr. Barnes, with Dr. Coker, determined the effect of temperature on stream lines and the critical velocity. He has also made a close study of the properties and peculiarities of ice formation in Canadian rivers. Freezing does not occur merely at the surface, as in most English rivers, but, after passing rapids, water may congeal at the bottom and form "anchor ice." Still more remarkable is the formation of "frazil," consisting of minute crystals pervading the whole mass of water. The presence of ice in this state occasions serious trouble in the turbines of the power stations, and special precautions are necessary to mitigate the evil.

On the appointment of Prof. Callendar to the chair of physics at University College, London, Prof. Cox again visited the Cavendish Laboratory, and, on the advice of Prof. J. J. Thomson, he selected to fill the vacancy E. Rutherford, a young man who had already distinguished himself for originality, insight, and great capacity for work. Soon after M. Becquerel's discovery of the radiations from uranium, Rutherford had published a paper on that subject, and removed some misapprehensions as to the properties of the radiations. Moreover, he had served a most useful apprenticeship on the investigation of the properties of ions, whether produced by Röntgen rays, ultra-violet light, or by uranium. This thorough mastery of the indispensable elements served him in good stead when he continued at Montreal his

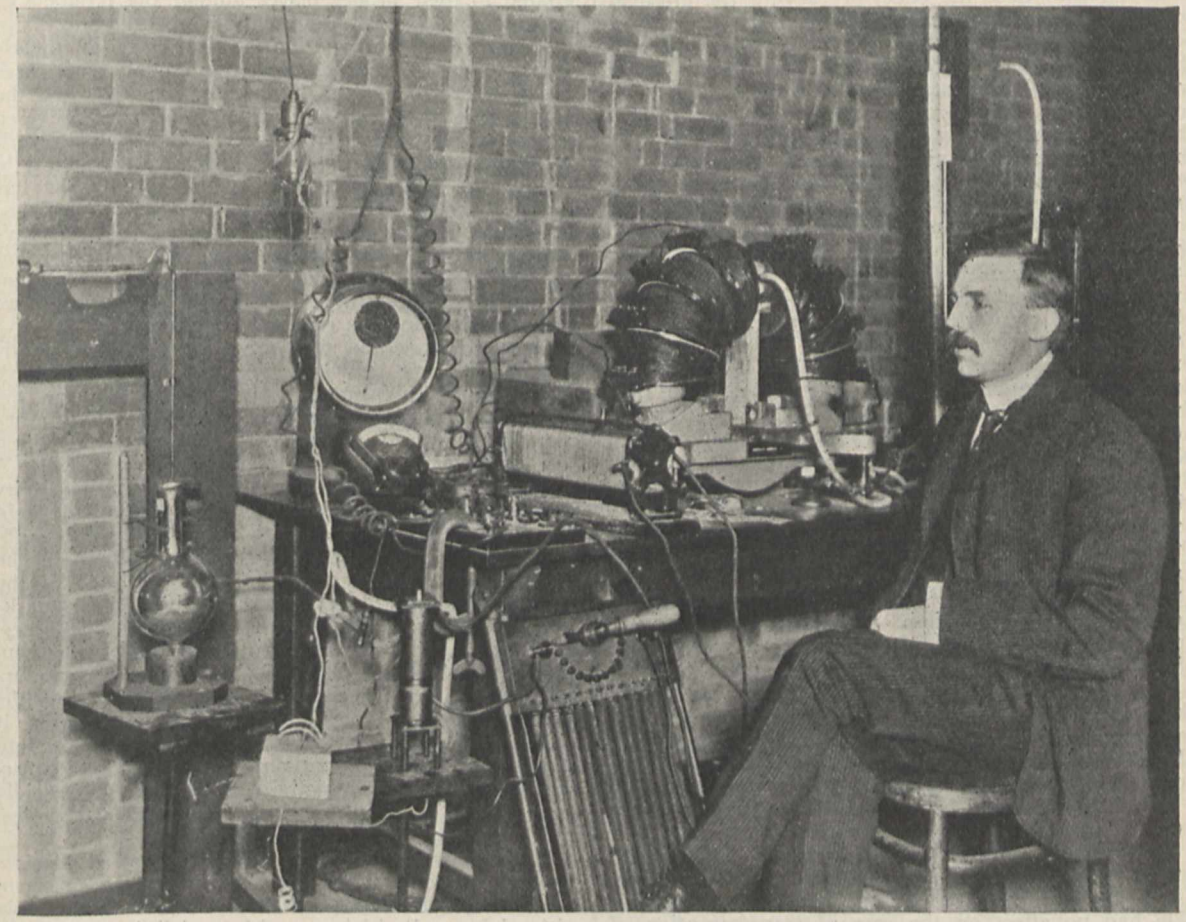

FIG. 2.—Prof. E. Rutherford, F.R.S., in his laboratory.

researches on radio-activity. At this time Prof. H. B. Owens, of the engineering building, had noted the peculiar inconstancy of the radiations from thorium, and traced it to air currents. Prof. Rutherford then made an exhaustive examination of the phenomena, and he found that thorium emitted a gaseous substance, to which he gave the name "emanation." He also proved that the emanation had the remarkable property of making other substances active by a material surface deposit due to the emanation. Assisted by Miss Brooks, he proceeded to measure the rate of diffusion of the emanation from radium, for he then saw, and saw correctly, that the emanation was a gas and a distinct form of matter.

At this point Mr. Soddy came from Oxford to McGill University and worked with Prof. Rutherford. Together they tried the effect of varying the physical conditions, such as temperature, upon the emanating power of radio-active substances, and in the course of this work it was found that the emanation came from thorium X, a substance which could be separated from thorium. When they realised and clearly proved that the emanation was produced from thorium X, that thorium X constantly appeared from thorium, and as constantly decayed, that the curves of decay and of recovery were strictly complementary, and followed with exactitude simple exponential laws, that the rate of change was proportional to the amount of material still unchanged, then for the first time a most clear conception of the sequence of production of matter in fresh forms, with distinct chemical properties, was attained. The substances thus discovered were in quantities too minute to be detected by the balance or spectroscope. The new theory of radio-activity was published in two papers by Rutherford and Soddy in the *Philosophical Magazine* of September and November, 1902. In these papers the experimental evidence was first reviewed, and then the theory was stated that radio-activity is an atomic phenomenon accompanied by chemical changes in which new types of matter are produced, that the changes must occur within the atom, and that the radio-active substances must be undergoing transformation. This theory on its first appearance was regarded by many as a mere flight of the imagination, and efforts were made to detect a cause exterior to the atom. The theory was stoutly championed by Rutherford in the face of doubt and criticism, and it is now so thoroughly accepted by all who have investigated the subject that the initial opposition is almost forgotten. It is remarkable that a new subject should have reached the position of an exact science with such great rapidity.

Experimental research continued at McGill with speed which was almost feverish. Having established the fact that the highest temperatures obtainable had no effect on the rate of transformation of the emanation of radium, it was desired to try the effect of extreme cold. Again the good genius of the Physics Building was invoked, and a complete plant for making liquid air was presented. Within a quarter of an hour after the first 100 c.c. of liquid air were prepared the emanation had been condensed, and the material nature of this gas had been proved beyond question.

It is noteworthy that in the paper on the cause and nature of radio-activity in the *Philosophical Magazine* of November, 1902, the speculation was advanced that the presence of helium in minerals associated with uranium and thorium might be connected with their radio-activity. In 1904 this forecast was verified by the observation of the presence of helium in the spectrum of the radium emanation by Ramsay and Soddy in the laboratory of the former. In the meantime Rutherford had proved by magnetic deflection that the α particles carried a positive charge. The remarkable heating effects of radium, three-quarters of the total amount being due to the emanation, were investigated and measured. At a later date the heat generated by the γ rays was under observation and found to be very small, a result of importance in estimating the nature of the rays. In these heat determinations Prof. Rutherford was assisted by Dr. Barnes. In 1902 Mr. Soddy left McGill University, worked for a year with Sir William Ramsay, and was then appointed lecturer in physical chemistry at Glasgow University. Prof. Rutherford continued his research work with unabated energy and success. Radio-tellurium and polonium were relegated to their proper places among the products of radium, now grown to a family of six, the successive offspring of the emanation. The theory of rayless changes was advanced, and the complicated cases arising therefrom were thoroughly explored, and the results published in the Bakerian lecture delivered before the Royal Society in 1904. The brilliant work of Rutherford received recognition by the award to him of the Rumford medal. More recently he has again directed his attention to the α particles, deflecting in electric and magnetic fields the rays from radium C and other substances, thus determining the charge and mass of the particles, and endeavouring to account for their abrupt disappearance whilst their velocities are still very great.

So much work and such novel theories have naturally called forth criticism, but the discussions have always been chivalrous, buttons have been on the foils, and Rutherford's extreme care in verifying every step by thorough experimental evidence has saved him from error to a degree quite exceptional. A prominent physicist in the early days of radio-activity remarked that the subject was such a tangled skein that it was almost hopeless to unravel it. This sufficiently indicates the difficulty of the subject in the initial stages. It is fortunate that so much of the development centred in a man to whom the remarkable instinct is given of rarely following side-issues. As a result of this concentration a uniform system of nomenclature has been adopted, and experimenters are saved much time and trouble in following the work of others. Apart from such concentration, it is not difficult to imagine the state of chaos into which the whole subject would have lapsed. Rutherford's work, "Radio-activity," has passed rapidly through two editions, has kept pace with discoveries, and is the encyclopædia of the subject.

At the physics building Prof. Rutherford inspires research students with some of his own enthusiasm and energy. He follows their results closely, is ready with advice and criticism, and is as delighted with any of their discoveries as with his own. He is generosity itself in giving a full measure of credit to those who do research work under his guidance.

Reference may be made to some of the work done by research students. Miss Brooks has published several papers on various radio-active phenomena, and this lady was one of the most successful and industrious workers in the early days of the investigation of the subject. H. L. Cooke discovered penetrating rays from the earth, and made contributions on the activity of ordinary matter. R. K. McClung determined the coefficient of re-combination of ions, and worked with Rutherford on the energy required to produce an ion, and on allied problems. S. J. Allan worked at the active deposit derived from the atmosphere and from falling snow. Miss Gates ascer-

tained the true nature of the discharge due to quinine sulphate. A. G. Grier detected the magnetic deviation of the β rays of thorium.

Others have come to Montreal from afar, attracted by the magnetic influence of Rutherford, such as Dr. Godlewski, of Lemberg, in Poland, who investigated in Montreal the products of actinium and some notable properties of actinium and uranium. From Frankfurt came Dr. Hahn, discoverer of radiothorium in the laboratory of Sir William Ramsay. Dr. Hahn, whilst working at McGill, also discovered radioactinium and a new product of thorium. Dr. Levin, from Göttingen, and Dr. Bronson, from Yale, have also done research work whilst at McGill, and the latter has increased our accurate knowledge of various radio-active constants by his modification of the electrometer giving direct and immediate readings. All these workers testify warmly to the inspiration kindled by Rutherford.

His own success as an investigator may be traced to a few well-marked characteristics. The first is the pertinacious and reiterated assault on the particular problem in hand. He does not grope in the dark for chance results, but bombards the particular point which he wishes to attack. He has also an instinctive insight which often makes his initial point of view more trustworthy than the deliberate conclusions of some befogged experimenter. He is not only an industrious, he is also a very rapid worker, but his experimental conditions are varied sufficiently to eliminate error, and his observations are repeated until he has perfect confidence in his results. Most noteworthy of all is the extreme simplicity and directness of his experimental methods. Some observers appear to grow happier as their apparatus becomes more complex. Rutherford selects some ingenious, straightforward attack, but the simplicity is supplemented by the genius which has enabled him to make such great contributions to our knowledge of the mutability of matter and of the atom in evolution.

In conclusion, the writer, who is an Englishman resident in Canada, ventures to emphasise the importance of research laboratories, so well equipped and so distributed that able men in Great Britain may not find themselves hampered through want of means and opportunity to pursue their work. The gift of the Cavendish Laboratory to the University of Cambridge by the late Duke of Devonshire has produced results which are recognised as holding the first place in recent advances in physical science. The Macdonald Physics Building has brilliantly started on its career. But there are other universities less fortunate, and there are other wealthy men.

A. S. EVE.

THE YORK MEETING OF THE BRITISH ASSOCIATION.

PROVISIONAL PROGRAMMES OF THE SECTIONS.

THE local arrangements for this meeting, which will be held at York from August 1 to 8, are progressing extremely satisfactorily, and a large assembly is expected, as nearly 1200 persons from a distance have already signified their intention to be present. The evening meetings will be held in the large hall of the Exhibition Building; 2200 numbered seats are already arranged, while there is space behind, making up a total accommodation of at least 5000 if necessary. All these will have a full view of the speaker, and the lantern screen, though, of course, those behind will be a considerable distance away. It will be well, therefore, for visitors to bring their opera glasses with them.

The neighbourhood of York affords many objects of interest, archæological, botanical, and geological, and many of these are more readily accessible by road than railway. Cyclists are therefore recommended to bring their machines with them, as the roads are mostly good and level. Hotel and lodging list can, as usual, be obtained of the local secretaries, Davy Hall Chambers, York. The following provisional programmes have been arranged by the committees of the various sections:—

SECTION A (MATHEMATICAL AND PHYSICAL SCIENCE).—This section will, as usual in recent years, meet in three departments. In the chief department a series of discussions has been arranged. Prof. Soddy will open one on the evolution of the elements, and a number of leading workers in radio-activity, including Sir Wm. Ramsay, are expected to follow. Mr. J. Swinburne will discuss the nature of the radiation from incandescent mantles; and Dr. H. Rubens, of Charlottenburg, will expound his views, and illustrate them experimentally. Representatives of the Chemical Section will be deputed to attend both these discussions. It is expected that they will prove of great value as well as of great interest. The Hon. R. J. Strutt has consented to give an account of his recent work on the internal structure of the earth as indicated by the phenomena of radio-activity, and Prof. J. Milne will also speak on it. It is probable that the Geological Section will collaborate in this discussion; hence it will be treated from various points of view. There will be a paper by the Earl of Berkeley on osmotic pressure, which will lead probably to renewed debate on the ever-interesting subject of the nature of solutions. Sir Wm. Ramsay and J. F. Spencer have presented a paper on chemical and electrical changes induced by ultra-violet light, which contains important new matter, as well as a summary of what is at present known on this subject.

There will also be papers by H. Stansfield on photographs of thin liquid films (with experiments); Prof. E. H. Barton and J. Penzer on photographic records of a string's vibrations and responsive motions in the air; Mr. C. E. S. Phillips on the production of an electrically conductive glass; and Prof. W. F. Barrett on entoptic vision. In the Department of Astronomy and Cosmical Physics, a joint discussion has been arranged with Section E (Geography) on the necessity for the re-measurement of the British geodetic arc. This will be opened by Major E. H. Hills, R.E. In the Department of Mathematics, Prof. A. R. Forsyth will read a paper on the different kinds of integrals of partial differential equations. Papers will also be read on a test for the convergence of multiple series, by Mr. T. J. Bromwich; on some notes on finite groups, by Harold Hilton; on Aleph numbers, by Dr. E. W. Hobson; and on the residues of hyper-even numbers, by Lieut.-Colonel A. Cunningham. Prof. Henrici will open a discussion on the notation and use of vectors.

SECTION C (GEOLOGY).—The following are among the principal papers promised for this section: The problems of the Palæozoic glaciations of Australia and South Africa, Prof. J. W. Gregory; On a criterion of the glacial erosion of lake-basins, R. D. Oldham; Notes on recent earthquakes, Prof. J. Milne; On anthropods from the Coal-measures, Dr. Hy. Woodward; On the Jurassic flora of Yorkshire, A. C. Seward; Discussion on the origin of the trias, opened by Prof. Bonney and Mr. J. Lomas; On an artesian boring at Lincoln, Prof. Hull; On the post-Cretaceous stratigraphy of Southern Nigeria, J. Parkinson; On a peculiar variety of sodalite showing colour-change, T. H. Holland. Prof. P. F. Kendall will give a lecture on the geology of the country round York. The president's address will deal with the interglacial problem as it applies to the British Isles. A number of other papers have also been promised—relating mainly to the geology of the Yorkshire district. The following are among the number: On the limestone knolls of Craven, and on an intrusive rock near Grindleton in the West Riding, A. Wilmore; Notes on the glaciation of the Usk and Wye Valleys, Rev. W. Lower Carter; On faults as a predisposing cause of the potholes on Ingleborough, H. Brod-

rick; On a section in a post-glacial deposit at Hornsea, T. Sheppard.

SECTION D (ZOOLOGY).—President's address by Mr. J. J. Lister, F.R.S. *Papers.*—Conjugation of *Paramaecium caudatus*, Prof. Gary N. Calkins (Columbia Univ.); Breeding experiments in canaries—an exception to Mendel's law, Prof. Noorduijn; Preliminary note on a new conception of segregation, A. D. Darbyshire; On epigamic and aposematic scents in rhopalocera, Dr. F. A. Dixey; Outline sketch of what appears to be a periodic law in organic evolution, with a re-estimation of the cell, H. M. Bernard; Maturation of parthenogenetic eggs, L. Doncaster; The milk dentition of the primitive elephants, Dr. C. W. Andrews; Habits of galatheidæ in relation to their structure, Dr. Herbert J. Fleure and Miss E. F. Galloway; Some points of interest with reference to the mandible in mammals, and Some remarks on the manus of the dolphin, Prof. R. J. Anderson; Title not communicated, but dealing with the zoology of the Scottish Antarctic Expedition, W. F. Lanchester. *Discussions.*—Halolimnic faunas and the Tanganyika problems, J. E. S. Moore; it is hoped the following will speak: Prof. Pilseneer, Dr. Bordenger, Prof. Gregory, Mr. Cunnington, Mr. Hudleston, Dr. Calman, Mr. R. T. Gunther. Melanism in Lepidoptera, G. T. Porritt; the following will speak: Mr. J. Arkle, Dr. Dixey, Mr. W. Hewitt, and others. Prof. Gary N. Calkins will introduce a discussion on Protozoan life-histories. Spicule formation, Prof. E. A. Minchin; it is hoped the following will speak: Prof. Yves Delage, Prof. Sollas, Prof. Dendy, Mr. W. Woodland. Suggestions for the more systematic study of oceanic plankton, Dr. G. Herbert Fowler; probable speakers: Prof. Gibson (Louvain), Dr. Norris Wolffenden, Mr. Stanley Gardiner. On the relations of scientific marine investigations to practical fishery problems, Dr. E. J. Allen; it is hoped that in addition to men of science a number of persons practically interested in the fishing industry at Hull and Grimsby will take part in the discussion. On Monday morning (August 6) there will be a joint meeting with Section K (Botany) for the discussion of several cytological papers, among which will be Mr. Doncaster's (*vide supra*). There will also be two afternoon lectures illustrated with lantern slides (semi-popular), namely: The habits of tube-building worms, Arnold T. Watson; Birds and mammals of Yorkshire, Oxley Grabham (local secretary).

SECTION E (GEOGRAPHY).—*Discussions.*—Proposed measurement of geodetic arcs in Great Britain, opened by Major E. H. Hills, C.M.G., R.E.; Changes on the coast of England, especially at the mouth of the Humber, opened by Mr. Clement Reid. *Papers.*—The scientific results of the Scottish Loch survey, James Murray; The Chagos Islands, Indian Ocean, J. Stanley Gardiner; A journey across the Sahara, M. E. F. Gautier (not quite certain); The structure of Southern Nigeria, John Parkinson; The study of Social Geography, Prof. G. W. Hoke, of Ohio State Normal College; A journey in the Central Himalaya, T. G. Longstaff; The future of wheat-growing in Canada, Prof. L. W. Lyde; Geographical photography, John Thomson. *Afternoon Lectures.*—Past and present in Asia Minor, Prof. W. M. Ramsay; The visit of the Association to S. Africa, H. Yule Oldham; A tour in South-East Persia, Major P. M. Sykes.

SECTION G (ENGINEERING).—Address by Prof. J. A. Ewing, president of the Section; Modern armour and its attack, Major W. E. Edwards; The deformation and fracture of iron and steel, W. Rosenhain; Segregation in steel ingots, and its effect in modifying the mechanical properties of steel, J. E. Stead; Structural changes in nickel wire at high temperatures, H. C. H. Carpenter; Standardisation in British engineering practice, Sir John Wolfe Barry, K.C.B.; Recent advances in our knowledge of radiation phenomena, and their bearing on the optical measurement of temperature, J. B. Henderson; The removal of dust and smoke from chimney gases, S. H. Davies and F. G. Fryer; Glow lamps up-to-date, and the grading of voltages, Sir W. H. Preece, K.C.B.; The advent of single phase electric traction on railways, C. F. Jenkin; Some recent developments of the steam turbine, G. Gerald Stoney; Some recent experimental results with internal combustion engines, Prof. W. E. Dalby; A general supply of gas for heat, light, and power purposes, A. J. Martin; Experiments illustrating the balancing of engines, Prof. W. E. Dalby; An indicator for high speed engines, Prof. B. Hopkinson; A new form of transmission dynamometer, Prof. B. Hopkinson and L. G. P. Thring; The new engineering laboratories, Edinburgh University, and their equipment, Prof. T. Hudson Beare; Waterproof roads as a solution of the dust problem, Douglas Mackenzie; The central technical college lecture table testing machine, Prof. Ashcroft; The teaching of mechanics by experiment (with illustrations), C. E. Ashford.

SECTION H (ANTHROPOLOGY).—In this section the proceedings promise to prove as interesting as usual, and quite a large number of the communications are likely to give rise to considerable discussion. One of the most important items in the programme will be a discussion on the head-form of the prehistoric and early historic races in Britain which has been arranged to take place in connection with an exhibit of British crania, now in the possession of the Yorkshire Philosophical Society, and crania from Laver Hill. The discussion will be opened by Mr. J. Gray with a paper surveying the evidence, anthropological and collateral, bearing on the affinities and probable origin of the prehistoric and early historic races which have settled in Britain. Dr. F. C. Shrubsall has also promised to contribute, and Dr. W. Wright and others will take part in the discussion. In this connection considerable interest attaches to a paper on the relations between archæological and anthropographical data in the ethnology of Scotland by Dr. T. H. Bryce, and a paper by Mr. J. R. Mortimer on the relation between stature and head-form in the skeletal remains found in the round barrows of Yorkshire, based on data obtained from his own collections at Driffield. Mr. H. Brodrick will describe a skeleton recently discovered in Scoska Cave, Littondale. Two communications by Dr. W. L. H. Duckworth will deal respectively with a rare anomaly in human crania from Kawiawata Island, New Guinea, and observations on a eunuchoid subject in the Cambridge Anatomy School. Dr. C. S. Myers contributes, as an addendum to the report of the committee on anthropometric investigations among the native troops of the Egyptian Army, and notes on the distribution of cephalic and nasal indices in different provinces of Egypt.

In general ethnography communications are hardly as numerous as usual. Dr. Haddon will contribute a paper on the ethnology of South Africa, based principally on material collected during the visit of the association to South Africa last year, and Mr. S. Dornan, a South African member, sends a communication dealing with the Bushmen of Basutoland. Messrs. T. A. Joyce and E. Torday jointly will contribute a paper on the Ba-Yakka, a tribe in the Congo Free State. Among papers dealing with points of a more detailed character, Dr. Rivers offers, as a possible explanation, alternative, at least in India, of the importance of the maternal uncle among primitive races, a survival in the marriage customs of southern India, and an account of the astronomy of the Torres Straits islanders. Mr. H. A. Rose will contribute a paper on the custom of female infanticide in India, and Prof. Ridgeway will deal with the origin of the fiddle and guitar. Dr. T. H. Bryce and Mr. Newberry, of the Glasgow School of Art, will exhibit a number of examples of the "door-step" art—designs used by peasants to decorate their door-steps and dairy and kitchen floors in Scotland, which present many interesting features.

In archæology, Prof. W. M. Flinders Petrie will give an account of a Hyksos fortress and other discoveries in Egypt in 1906; Dr. R. C. Bosanquet will describe his excavations in Sparta, and a communication from Mr. J. L. Myres will deal with early traces of human types in the Ægean. Mr. D. G. Hogarth hopes to communicate an account of the treasures of the primitive Artemisia of Ephesus, should the interval before the meeting be sufficient to allow an examination of the objects from the site, which have only just arrived in England. Major P. M. Sykes will exhibit a collection of bronze weapons and implements from Persia, which are discussed in a communication by the Rev. Canon Greenwell. Dr. T. Ashby will read papers on the recent excavations in the Forum, and the excavations at Caerwent in 1904–6. Prof. R. S. Conway

will contribute a paper on the Keltic weights found at Melandra, which throw considerable light on the subdivisions of the pre-Roman pound in Britain. Excavations on the interesting palæolithic site at Ipswich, of which accounts have on two occasions been presented to the section, have now brought to light a number of small implements which would appear to have been used as scrapers, and further evidence as to the relations of the implementiferous strata, which will be described by Miss Layard. Miss Layard also contributes an account of the excavation of an Anglo-Saxon cemetery at Ipswich, which has produced, among other objects, fibulæ of interesting types, rare in Great Britain. Mr. Rudler's paper on the "Red Hills" of the east coast salt-marshes will describe the low mounds of burnt earth of frequent occurrence on the estuarial marshes of Essex, which it is now proposed to examine systematically.

SECTION I (PHYSIOLOGY).—*August* 2: Address by the president, Prof. Gotch; Report of committee on The metabolic balance sheet of the tissues; Papers on physiology. *August* 3: The nitrification of sewage, Dr. George Reid; Papers on hygiene; Report of the committee for the investigation of the effect of climate upon health. *August* 5: Discussion on the physiological value of rest, opened by Dr. T. D. Acland. Dr. Rivers, Dr. Myers, Prof. McDougall are expected to take part. Papers on the special senses, psychology and electrophysiology. Dr. Bevan Lewis and Dr. Smith will give a demonstration on improved methods of studying the central nervous system, and a paper on the pericellular plexus and neuro fibrils of the cerebral cortex. *August* 6: Joint discussion with Section B (Chemistry) on the factors which determine minimum diet values, opened by Dr. F. Gowland Hopkins. This, of course, has special interest, as much sociological work has been done in York by Mr. B. Seebohm Rowntree on the limits of diet. Prof. Armstrong and other members of the chemical section will take part. Papers on pathology. *August* 7: General papers.

SECTION K (BOTANY).—At least three of the sessions of this section will be devoted to special topics of current interest, the proceedings in each opening with a general paper or address dealing with the topic as a whole, followed by more special papers and a general discussion. The three topics chosen for the present meeting are as follows:—(1) Some aspects of the present position of Palæozoic botany will be dealt with by Dr. D. H. Scott, F.R.S., and the conditions of growth of Carboniferous plants by Prof. F. E. Weiss, Miss M. C. Stopes, and others. (2) The nature of fertilisation and kindred problems, at a joint session with Section D (Zoology). Mr. V. H. Blackman will open the proceedings with a general address setting forth the present position of the subject. Prof. Farmer, F.R.S., is expected to contribute a paper on the cytological features of apospory, and Mr. Doncaster one on some cytological features of animal parthenogenesis. Several eminent foreign botanists, distinguished for their work on kindred topics, have promised to be present, among them being Prof. Tschermak, of Vienna, Prof. Johannsen and Dr. Ostenfeld, of Copenhagen, Dr. Rosenberg, of Stockholm, and Dr. Lotsy, of Leyden. (3) The phylogenetic value of the vascular system of seedlings. Mr. A. G. Tansley and Miss E. N. Thomas will open the proceedings, while Prof. Jeffrey, of Harvard, Messrs. A. W. Hill, T. G. Hill, and Miss Ethel Sargant are expected to contribute by papers or otherwise to the discussion.

Dr. T. W. Woodhead, who has been spending the last year at Zurich with Prof. Schröter, will communicate a paper on ecological work in Switzerland, Mr. C. E. Moss will give an account of survey work and mapping in Somersetshire, while Dr. Fritsch and Mr. Walker will contribute papers on algal ecology. Prof. Wyndham Dunstan, F.R.S., is expected to give a general account of his work on hydrocyanic acid in metabolism, but it is not yet certain whether this will be presented to the botanical or to the chemical section. Among other papers may be mentioned Prof. H. H. W. Pearson's on the habitats and habits of S. African cycads, communicated by Mr. A. C. Seward, F.R.S., and Mr. Hugh Richardson's on the vegetation of Teneriffe. It is hoped that Dr. Blakeslee may be able to be present and give an account of his work on sexual differentiation in the Mucorineæ, and also of his important recent discoveries of sexual differentiation in the spores of Marchantia.

SECTION L (EDUCATIONAL SCIENCE).—*August* 2: Presidential address, Prof. Michael E. Sadler; Report on health in schools, Prof. Sherrington; Medical inspection of schools and colleges, Sir Lauder Brunton, Sir Henry Craik; Physical training, Dr. Ethel Williams, Major Norman; The education of workpeople, Hugh O. Meredith. *August* 3: Curriculum of primary schools and the training of teachers in such schools; Report of committee on the courses of practical, experimental, and observational studies most suitable to elementary schools: general principles, Sir Philip Magnus, M.P., subcommittee report on arithmetic and mensuration, Prof. R. A. Gregory, subcommittee report on nature-study, Hugh Richardson. Contributions to the discussion will be made by Principal Burrell, T. S. Dymond, Prof. Green, J. C. Hudson. Training for the home duties of women. Report of subcommittee on Domestic studies, Geo. Fletcher. The following will contribute to the discussion:—Miss Mary E. Marsden, Prof. A. Smithells, Miss Maud Taylor, Prof. H. E. Armstrong, Mrs. Margaret Pillow, B. S. Rowntree, Mrs Marvin, Miss Romley Wright. *August* 6: The balance of subjects in the curriculum of the secondary school and the training of teachers for such schools, T. E. Page, Hon. and Rev. E. Lyttelton, Rev. E. C. Owen, Arthur Rowntree (Leisure pursuits), Gidley Robinson (Preparatory schools), C. M. Stuart, J. H. Leonard, Miss E. E. C. Tomes (Training), Prof. Raymont (Training); The uncertainty of educational values in the absence of scientific experiment, Dr. E. P. Culverwell; The demonstration school as a field for scientific research in school teaching, Prof. J. J. Findlay. *August* 7: Inspection and examination of schools, C. M. Stuart, J. L. Holland, Geo. Fletcher, and others; The teaching of modern languages, Prof. Wyld, Prof. Robertson; Experiments and results in elementary modern language teaching conducted since 1892, Prof. J. J. Findlay; (joint meeting with Sections A and G) The teaching of mechanics by experiment, C. E. Ashford.

NOTES.

THE death of Prof. Drude by his own hand at the early age of forty-three is a serious loss to physical science. Born at Brunswick in 1863, he made his mark first as a pupil of Voigt at Göttingen, and his series of papers in which he applied the electromagnetic theory of Maxwell, as developed by Herz, to the problems of light, stamped him as a physicist of the first rank. These appeared in *Wiedemann's Annalen* in the years 1896–9, and as more fully developed in the author's "Physics of the Ether" and his text-book of optics, have received recognition in these columns. Among them may be specially noted his theory of the magneto-optic phenomena of iron, nickel, and cobalt, 1897; the theory of anomalous dispersion, 1898; and of electric dispersion, 1899. Drude was also an experimenter, and was able to devise and carry out critical experiments to test, where necessary, fundamental points of his theory. In 1900 he succeeded Wiedemann as editor of the *Annalen der Physik*, and under his capable guidance that well-known journal has fully maintained its reputation, while only last year he was called to Berlin as professor of physics in succession to Warburg, now president of the Reichsanstalt. The physics school of the University of Berlin has suffered severely in recent years, and the loss of the brilliant physicist who had so recently joined them will be deeply felt by his friends and colleagues.

THE report on the civil hospitals and dispensaries in the United Provinces states, says the *Pioneer Mail*, that five cases of snake-bite have been successfully treated at Gorakhpur with Dr. Calmette's anti-venene and permanganate of potash. They seemed bad cases, and almost

immediately recovered after the injection of the serum. Twenty-two cases were also treated in the Banda district, and in twenty-one cases the treatment was successful.

THE death of M. Edouard Piette in his eightieth year removes from the ranks of French anthropologists a tireless investigator. He began to write on prehistoric questions as long ago as 1869, and contributed numerous articles to periodicals, among which may be mentioned a supplement to *L'Anthropologie*, entitled "Les Galets coloriés du Mas d'Azil," splendidly illustrated in colours. Another work was entitled "Les Tertres funéraires d'Avezac-Prat"; but a great part of his material remains unpublished, though some of the plates illustrative of it were exhibited at the Trocadéro some years ago. He formed a magnificent collection of stone, bone, and early iron objects from Brassempouy, Mas d'Azil, and other places, and presented it about four years ago to the Museum of Saint-Germain, where it is arranged in stratigraphic order. He was an honorary fellow of many learned societies, but, his generous benefaction notwithstanding, he was neither a member of the Institute nor the recipient of a decoration.

THE death of the Rev. J. F. Blake will be felt by many British geologists as a personal loss. Prof. Blake was born in 1839. He was educated at Christ's Hospital and Caius College, Cambridge, where he was senior scholar. In the natural science tripos of 1862 he took a second class, and he was fifteenth wrangler. Following the profession of his father, the Rev. Robert P. Blake, he entered the Church, and held curacies at Lenton, near Nottingham, and at St. Mary's, Bryanston Square. Afterwards he went as mathematical master to St. Peter's School, York, a post he occupied for nine years. From 1876 to 1880 he was lecturer at Charing Cross Hospital on comparative anatomy. From 1880 to 1888 he held the chair of natural science at University College, Nottingham. In 1895 he went out to India to arrange the Baroda Museum. Prof. Blake was an active Fellow of the Geological Society of London, and in 1891–2 he was president of the Geologists' Association. His contributions to geological literature cover a wide field, but the ground he made particularly his own was the Jurassic of England. Many of his papers will be found in the Journal of the Geological Society, in the Palæontological Society's monographs, and elsewhere. A characteristic publication was the "Annals of British Geology," an excellent work, which doubtless failed through containing too fully the marks of Prof. Blake's strong critical capacity. His natural enthusiasm and integrity of character endeared him to all with whom he came really in contact.

MR. F. VICTOR DICKINS informs us that on August 21 the session of the Congrès préhistorique de France will open at Vannes, the curious old capital of the Morbihan, under the presidency of M. A. de Mortillet. All necessary information will be readily afforded by the general secretary, Dr. Marcel Baudouin, Paris, rue Linné 21. The subscription and cost of excursions are extremely moderate, and for ten francs a day, all comprised, the very best accommodation is procurable at Vannes. The session will close on August 26; and arrangements are made for a reduction of the fares on the French railways.

THE *Daily Chronicle* of July 6 publishes a Reuter telegram of the previous day from Rome announcing that the Duke of the Abruzzi had telegraphed to the King of Italy that on June 16 he reached the highest point of Mount Ruwenzori. The probable position of this peak, as deduced from a combination of the best data available, may be gathered from a paper by Lieut. T. T. Behrens, R.E., in the current number of the *Geographical Journal*. Lieut. Behrens makes use of (1) trigonometrical determinations of two tops of a summit; (2) trigonometrical rays to four other summits; (3) eight perspective views from sketches and photographs, with some magnetic bearings; (4) a map compiled from all available sources up to 1901, chiefly based on Dr. Stuhlmann's traverse and astronomical observations; and (5) information just received from Mr. A. F. R. Wollaston, a member of the zoological expedition sent out under the auspices of the Natural History Museum, who with two other members of the expedition made a number of ascents in this range during April last.

THE Country in Town Exhibition, which was opened by Princess Christian on July 5 in the Whitechapel Art Gallery, has proved in every way as successful as its promoters could have wished. The chief objects of the exhibition are to show how many interesting remnants of the country and its denizens there still remain in London, to suggest how much of the country can be brought back to town, and to indicate those places near the metropolis (which can be reached at trifling cost) where the beauties of nature can easily be enjoyed. In connection with the exhibition, a series of lectures was arranged, the first being given by Mr. Richard Kearton, on Nature at work and play. Dr. Henry, in dealing with the question of tree planting in London, showed that it was the way the trees were treated rather than the injury caused by the atmosphere which prevented them from growing. Mr. T. S. Dymond gave many useful hints in connection with the soil of London, Sir John Cockburn outlined the way in which Australian cities have been beautified by tree planting, Mr. Herrod dealt with bees, and Mrs. Dukinfield Scott showed her animated photographs of plants. The chairman of the executive committee is Mr. J. C. Medd, and the honorary secretary is Mr. Wilfred Mark Webb.

FROM a resolution published in the *Pioneer Mail* (June 15) it appears that the Government of India has had under consideration the desirability of making better provision for scientific research in connection with Indian forests. In order to provide a staff of experts who will be in a position to devote a large proportion of their time to the prosecution of scientific research connected with forest produce, as well as to give the best available training to candidates for the forest services, both of British India and of native States, the Indian Government has, with the sanction of the Secretary of State, decided to raise the status of the existing Imperial Forest School at Dehra Dun, and to add to its staff. The school will now be known as the Imperial Forest Research Institute and College, and the staff will include six officers of the Imperial Service holding the following posts:—(1) An Imperial sylviculturist, who will make sylviculture his special study. (2) An Imperial superintendent of forest working plans, who will collect and collate statistics of the results of forest management throughout India. (3) An Imperial forest zoologist, whose chief duty will be to investigate the damage caused by insects and other pests, and to suggest remedial measures. (4) An Imperial forest botanist, who will study the botany of forest plants, diseases of trees, and distribution of species. (5) An Imperial forest chemist, who will investigate the chemical properties of soils and of the produce of the forests. (6) An Imperial forest economist, who will make a special study of the best methods of rendering forest produce of all kinds available at the smallest cost to consumers, and will keep in touch with the commerce of India with the view of fostering and meeting the demand for forest products.

COMMUNICATION by wireless telegraphy has just been established between the Australian continent and Tasmania by the Marconi system.

THE foundation stone of the German Museum "für Meisterwerke der Technik" is to be laid in Munich about the middle of November, in the presence of the Emperor of Germany.

THE Magdeburg civic authorities have decided to pay for the erection of a laboratory for the examination of food materials in connection with the new State bacteriological laboratory which is shortly to be built.

THE income of the jubilee fund founded in Heidelberg in 1886, and to be awarded to teachers in the university in recognition of their scientific work, has been divided between Prof. Fr. Pockels, professor of physics, and Prof. A. Klages, professor of chemistry, to enable the latter to continue his investigations on optically active benzoyl derivatives.

PROF. K. SEUBERT has retired from the International Atomic Weights Subcommittee on account of over-pressure of work. His place will be taken by Prof. W. Ostwald, so that the subcommittee will now consist of Profs. T. E. Thorpe, H. Moissan, W. Ostwald, and F. W. Clarke, president.

A STANDING exhibition committee is to be formed in Berlin by the Zentralverband deutscher Industrieller, acting in conjunction with the Zentralstelle für Vorbereitung von Handelsverträgen and with the Bund der Industrieller. The duties of this committee will be to collect information with regard to all exhibitions of importance and to deal with questions affecting the interests of German exhibitors, both at home and abroad.

A LEGACY of 360,000 francs has been left to the French Academy of Sciences and a few other institutes under the will of the late Baron de Rey. To the Academy itself is bequeathed the sum of 150,000 francs, from the interest on which there is to be offered quinquennially a prize of 20,000 francs to the French investigators who, in the opinion of the Academy, have best contributed to the progress of physical science.

PUPILS and friends of the late Prof. August Kekulé, who died in 1896, have handed over to the University of Bonn a sum of 31,500 marks, the yearly interest on which is to be given to a young investigator of the exact sciences, more especially chemistry and physics, on July 13 of each year, the anniversary of Kekulé's death. The first payment is to be made after the relatives of the deceased chemist have no further claim on the income of the fund as arranged.

THE Deutscher Verein für öffentliche Gesundheitspflege will hold the annual general meeting this year on September 12 to 15 in Augsburg immediately before the beginning of the meeting of the Deutsche Naturforscher und Aerzte in Stuttgart which begins on September 16. The subjects to be proposed for discussion include:—(1) Precautions against hydrophobia, (2) the milk supplies of towns, with special reference to the milk supplies for young children, (3) invalid homes, (4) the dust plague in the house and on the streets, (5) the hygiene of small houses.

IN No. 55 of the *Chemiker Zeitung* will be found some interesting details of the imports and exports of Germany for the year 1905; the estimated total value of the former is given as nearly 7500 million marks, and that of the latter as nearly 6000 million marks. Of these, 430 million marks are imported chemicals, including both raw and manufactured substances, and 473 million exported raw and manufactured chemicals; it is noteworthy that the imported raw stuffs for the chemical industries is put down at nearly 300 million marks in value, and the exported at 57 million.

WITH the view of cultivating an intelligent interest in meteorological science, the council of the Royal Meteorological Society appointed the assistant-secretary of the society, Mr. W. Marriott, last year to act in cooperation with scientific societies, institutions, and schools as a lecturer on meteorological subjects. The experiment has proved so successful that it is being continued, and a list of lectures for the coming lecture season has just been issued. Particulars can be obtained from the society, 70 Victoria Street, S.W.

AN article on hybridisation and plant breeding in the July number of the *Monthly Review*, written by Mr. A. J. Bliss, affords a timely introduction to the subject that will shortly attract public notice when in the course of the month the third triennial conference on plant breeding will be held in London under the auspices of the Royal Horticultural Society. Premising that there are continuous variations and discontinuous variations, the writer proceeds to show how variations have been produced by cultivation and selection alone, as in the case of Shirley poppies, or more easily and rapidly by cross-fertilisation. To fix the type, thanks to Mendel, certain principles are being evolved for the guidance of the breeder. The elucidation of these principles and other problems will be discussed at the conference. The article concludes with some interesting details of results already obtained and future possibilities.

IN their thirty-fourth annual report (for 1905) the directors of the Philadelphia Zoological Society state that they are considering a plan for lectures on animals to be given in the gardens at such times as they are most frequented by children. Special attention is directed to the valuable results attained by the introduction of a pathological laboratory. "No monkey is now placed upon exhibition unless it has successfully passed the tuberculin test, and it is hoped that by the employment of every practicable measure of prevention within the building, including prohibition of feeding by visitors, the occurrence of tuberculosis in these susceptible animals may be brought under control. A temporary result of the rigid system which has been put in practice is that the collection in the Monkey House is less complete than is usually the case. . . . Of those procured a considerable number failed to pass the tests and have not got beyond the quarantine-room."

IN a paper on additions to the exhibited series of fossil vertebrates in the U.S. National Museum, published in the Proceedings (No. 1460) of that institution, Mr. C. W. Gilmore figures another specimen of a pterodactyle from Eichstatt showing the impressions of the wing-membranes, and also the skull of a new horned dinosaur of the genus Triceratops. Japanese fishes form the subject of a paper in the same serial (No. 1462) by Messrs. Jordan and Starks, while in No. 1464 the former writer reviews the sand-lances (Ammodytidæ) of Japan, and in No. 1470 he describes, in conjunction with Mr. R. C. McGregor, a new threadfin-fish of the genus Polydactylus from Japan.

Dr. Stejneger in No. 1471 describes a new tree-frog (Hyla) from Costa Rica; East African birds, by Mr. H. C. Oberholser, form the subject of No. 1469; while in No. 1472 Mr. E. S. Miller discusses mammals from Engano Island, off Sumatra. Certain American moths are described in Nos. 1463 and 1465 by Mr. A. Busck.

IN a paper contributed to part iii. of vol. xxv. of Gegenbaur's *Morphologisches Jahrbuch*, Mr. J. E. V. Boas makes the startling announcement that a pleural cavity is absent in the Indian elephant. The author believes the feature to be constant, and that it will be found to hold good also for the African elephant, in which case we shall have a feature distinguishing the group from all other mammals. This paper is followed by one by Prof. G. Ruge on the shape of the thoracic cavity in the Indian elephant, and the relations thereto of the lungs. In a third paper Mr. A. Rauber contrasts the skull of Immanuel Kant with that of a member of the Neanderthal race. A striking difference between the two crania is to be found in the extreme brachycephalism of the one and the equally marked dolichocephalism of the other. If it be suggested that the shortness of the savant's skull was due to inheritance—from his ancestors in Scotland and Nürnberg—this is merely evading the main question, namely, When did the first brachycephalic man appear? It is noteworthy that if Kant's skull be plotted on the dolichocephalic lines of that of the Neanderthaler, and the Neanderthaler's cranium drawn on the brachycephalic proportions of that of Kant, the normals from a line connecting the "ophrion" with the "basion" will be very nearly the same in both cases.

THE *Bio-Chemical Journal* for June (i., Nos. 6 and 7) contains several interesting papers. Prof. Moore and Messrs. Alexander, Kelly, and Roaf show that the secretion of gastric hydrochloric acid is very sensitive to any variation in general health of the body, any enfeeblement leading to decreased percentage of the acid. This reduction in acid-secreting power is much more marked in cancer than in any other condition. Prof. Moore and Mr. Wilson contribute a paper on a clinical method of hæmalkalimetry which seems to be a distinct advance on previous ones.

THE longevity of *Bacillus typhosus* in natural waters and in sewage forms the subject of an important paper by Messrs. H. L. Russell and C. A. Fuller (*Journ. of Infectious Diseases*, Supp. No. 2, February, p. 40). Permeable sacs of celloidin, parchment, and agar were employed to imprison the typhoid organisms while exposed to the influence of water and sewage bacteria. When *B. typhosus* was exposed to the action of flowing lake water (Mendota), the longevity of the organism ranged from eight to ten days; when exposed directly to the action of sewage bacteria, its longevity was reduced to three to five days.

IN Bulletin No. 104 of the Agricultural Experiment Station, Morgantown, West Virginia, Mr. J. L. Sheldon writes on the ripe rot or mummy disease of guavas, ascribed to the fungus *Glomerella psidii*. Brown spots appear on the ripening fruits causing them to shrivel, whence the term mummy disease; if not identical with the bitter rot of apples it is very similar, and it was found possible to inoculate apples with the fungus. Delacroix assigned the fungus to the genus Glœosporium, but on account of the ascigerous stage observed by Mr. Sheldon he refers it to the genus Glomerella.

EXPERIMENTS on the tapping and preparation of rubber from Castilloa trees are in a less advanced stage than experiments with *Hevea latex*. As Castilloa promises to be more suitable for cultivation than Hevea in parts of the West Indies, considerable interest attaches to the preliminary results outlined in the West Indian Bulletin (vol. vii., part i.) by Mr. J. C. Moore for St. Lucia and Mr. J. Jones for Dominica. A variation in the semi-circumferential method of tapping is described, where, instead of a continuous cut, a series of incisions are made with a chisel. Castilloa is found to thrive on land suited to cacao, and may be grown on a shade tree for cacao; it possesses the further advantage of being able to withstand severe storms.

IT is interesting to note how the trade of each of the West Indian Islands possesses its own special features. Dr. F. Watts reviews the changes that have occurred in the agricultural industries of Montserrat in the West Indian Bulletin, vol. vii., No. 1, of which the most prominent facts are the decadence of the sugar industry and the marked fluctations in the production of lime and lime-juice. The raising of cattle and stock for export shows a steady increase, and a *papain* industry has been developed, which, however, is threatened by competitive production in the East. Cotton is regarded by Dr. Watts as the most hopeful industry for the future, but the peasant population has not, so far, taken to the cultivation. In the course of another article, Dr. Watts outlines the development of the cotton industry in the Leeward Islands since 1900, the greatest changes having been effected thereby in Nevis and Anguilla.

THE completion of the Simplon Tunnel, 12¼ miles in length, at a cost of 3,100,000*l*., and at an average rate of two miles a year, has induced Mr. Lewis M. Haupt to publish in the Journal of the Franklin Institute (vol. clxi., No. 6) some comparative notes on other great tunnels. The Hoosac Tunnel, Massachusetts, five miles in length, was begun in 1854 and completed in 1876, with an average progress of 5·5 feet per day. The Mont Cenis Tunnel, eight miles in length, was begun in 1857 and completed in 1871, with an average progress of 8 feet per day. The Sutro Tunnel, Nevada, four miles in length, was begun in 1869 and completed in 1878, with an average progress of 10·24 feet per day. The St. Gothard Tunnel (1872–1881), 9¼ miles in length, was driven at the rate of 14·6 feet per day. The Arlberg Tunnel (1880–1884), 6·38 miles in length, was driven at the rate of 27·8 feet per day.

THE third number of *Concrete and Constructional Engineering* (July) shows a marked improvement on the previous issues. The principal articles deal with reinforced concrete in France, reinforced concrete bridges, steel and concrete buildings in Scotland, reinforced concrete water mains, the theory of reinforced concrete, and hollow concrete blocks. The illustrations are excellent, and the articles are written by recognised authorities. An editorial note deals with the need for international standards in respect to reinforced concrete, and suggests that the International Association for Testing Materials should form a committee to collect international data. There is also a portrait and obituary notice of the octogenarian Joseph Monier, who died in Paris on March 13 last, almost unknown, almost forgotten, and in unfortunate circumstances, yet credit will always be due to him as the inventor of reinforced concrete.

THE blackening of rocks in rivers has of late received some attention from geologists. Mr. A. Lucas, chief chemist to the Geological Survey in Cairo, sends us a paper on the blackened rocks of the Nile Cataract (National

Printing Department, Cairo, 1905; for the Ministry of Finance). The dark outer film is similar to that well recognised as a characteristic of stones in deserts. The desert-film has been examined separately, and Mr. Lucas agrees with Walther that "the colour is much the darker the more the silica content of the rock." "The depth of colour is dependent upon the amount of black oxide of manganese in the film, and this is conditioned first by the manganese content of the rock, and secondly by the opportunities presented for the manganese salts to be brought to the surface and oxidised." "A hot climate and a small rainfall are necessary to the formation and preservation of the film." In regard to the river-film, it is noted that certain incised stones at the First Cataract are equally black on their surface and in the hollows of the inscriptions. Silica is one of the minor constituents of the river-film, but is absent from the desert-film. Mr. Lucas, after discussing previous literature and his own analyses, concludes that the river-film arises from material in the rocks themselves, as in the case of the analogous desert-film. Dr. W. F. Hume contributes a description of the microscopic characters of the rocks examined, with the general result that no connection can be established between the surface-film and any special decomposition in the outer layers.

THE June number of the *National Geographic Magazine* contains an account of a visit to Vesuvius after the eruption of April 8. The account is illustrated by a number of reproductions from photographs, of which we reproduce one showing the aspect of the cone after the eruption. The scoring of the slope of the cone is due to slipping of the loose ashes, not to stream action.

FIG. 1.—The new cone of Vesuvius from the road to the observatory, covered with white volcanic ash. From the *National Geographic Magazine*.

THE current number of the *Home Counties Magazine* contains an interesting article on old pewter by Mr. H. M. Cooke. In a broad sense pewter is composed of tin alloyed in varying quantities with antimony and copper; lead, bismuth, and zinc are sometimes also employed. The variety and constant change of colour are due to the difference of alloys and to atmospheric influence. The colour is in some measure dependent on the surface being good. As a domestic article, pewter succeeded wood, and was used almost universally until earthenware became cheap. It did not come into general domestic use until the seventeenth century. On account of its fusibility pewter was used by goldsmiths to take castings of certain articles. Benvenuto Cellini is said to have used it for this purpose in connection with his work. It appears from Mr. Cooke's article that dealers nowadays, to enhance the value of their wares, often point to the small marks in shields of a lion rampant or a leopard's head crowned, and describe articles bearing these as "silver pewter." But such marks indicate no special value in the metal, and except for the infinitesimal quantity that there may be in the lead employed, it is safe to assume that old pewter contains no silver.

IN a paper on the rapid measurement of geodesical bases published in part i. of the Bulletin of the French Physical Society, Dr. C. E. Guillaume gives details of the construction and use of the standards and measuring wires referred to in his article on invar (NATURE, vol. lxxi., p. 138). An account is given, in particular, of the rapid, direct measurement of base lines by means of stretched wires of invariable length. This process is extremely rapid as compared with older methods; in good country, ten or twelve men can measure up 5 to 6 kilometres per day, whereas with a bimetallic scale fifty men are required, and the distance covered per day does not exceed 400 metres. Formerly the number of bases directly measured was kept as small as possible, nearly all the values being obtained by triangulation. The use of these measuring wires of invariable length affords a means of controlling the older data, and will change the character of future surveys by increasing the number of direct data at the expense of those obtained by triangulation.

THE third volume of the contributions from the Jefferson Physical Laboratory of Harvard University for the year 1905 has been received. The previous volumes were described at some length in NATURE for March 1 last (vol. lxxiii., p. 427). The results of the investigations published in the present volume were obtained largely by the aid of the Thomas Jefferson Coolidge fund for original research. Nine of the twelve papers have already appeared in the Proceedings of the American Academy, and most of the contributions have been dealt with already in notes published in these columns.

THE *Electrician* Printing and Publishing Company, Ltd., is issuing a new series of *Electrician* primers at 3*d*. each, post free. A complete list of the primers will be sent on application. From an examination of specimens dealing with thermopiles, Röntgen rays and radiography, influence machines, the induction coil, the magnetic properties of iron and electrical units, it is clear that the series will prove of service to technical students.

THE *édition de luxe* of the Great Eastern Railway Company's handbook, "Summer Holidays," by Mr. Percy Lindley, is provided with an excellent series of facsimiles of water-colour drawings of places of interest in the eastern counties. In addition to the illustrations in colour, the pen and ink drawings, the letterpress, the list of golf links, and other information provided, combine to make the publication a useful holiday guide.

OUR ASTRONOMICAL COLUMN.

REDISCOVERY OF FINLAY'S COMET (1906*d*).—A telegram from the Kiel Centralstelle announces the rediscovery of Finlay's comet by Herr Kopf on July 16. The position of the comet at 13h. 14·4m. (Königstuhl M.T.) on that date was :—

R.A. = 23h. 38·3m., dec. = 14° 3′ S.

The object is stated to be a bright one. Subjoined is an extract from the approximate ephemeris published by Herr Schulhof in No. 4100 of the *Astronomische Nachrichten* :—

12h. M.T. Paris.

1906	α (true) h. m.	δ (true) ° ′	log Δ
July 16	23 44 ...	−13 7 ...	9·5443
18	23 57 ...	−12 10 ...	9·5254
20	0 11 ...	−11 6 ...	9·5073
22	0 25 ...	− 9 56 ...	9·4902
24 ...	0 40 ...	− 8 40 ...	9·4744
26	0 56 ...	− 7 17 ...	9·4602
28	1 13 ...	− 5 47 ...	9·4478
30	1 30 ...	− 4 12 ...	9·4376
Aug. 1	1 47 ...	− 2 33 ...	9·4299

A comparison of the observed and computed places on July 16 will give an approximate value for the corrections to be applied to the ephemeris positions. When rediscovered, the comet was about one degree north of ω Aquarii; at present (July 19) it is presumably about five degrees north of 2 Ceti, and is travelling in a north-easterly direction, so that it now rises above the south-east horizon at about 11.30 p.m.

THE ORBIT OF CASTOR.—An interesting paper on the quadruple system of Castor, by Dr. H. D. Curtis, appears in No. 5, vol. xxiii., of the *Astrophysical Journal*.

The discussion is based on the results obtained from a number of spectrograms, of each of the two double systems, taken with the Mills spectrograph at the Lick Observatory. For the fainter component, a_1, of the visual system, the final elements deduced give the period as 2·928285 days, the eccentricity as 0·01 ± 0·0066, and the velocity of the system as −0·98 ± 0·15 km. The comparison of these elements with the observational results shows a satisfactory agreement. Reducing the observational results for the brighter component, a_2, Dr. Curtis obtained a final set of elements which give the period as 9·218826 days, the eccentricity as 0·5033 ± 0·0112, and the velocity of the system as +6·20 ± 0·17 km.

Combining these results with those obtained for the visual system, it should become possible to obtain values for the parallax, masses, and other physical constants of this remarkable quadruple system, but the visual results, as shown in a table given by Dr. Curtis, are as yet so indeterminate that any values so obtained could not be looked upon as being in any way final. The relative velocity of the two components as derived from Dr. Curtis's discussion is 7·14 ± 0·23 km., and, taking Prof. Doberck's period of 347 years for the visual system, this would indicate a parallax of 0″·05. On a similar assumption the semi-major axes of the two systems are as follow :—

a_1 Geminorum, $a = 1{,}435{,}000$ km.
a_2 ,, $a = 1{,}667{,}000$,,

Although these results are mere hypotheses, they give some idea of the magnitude of each system, and show that they are probably of about the same dimensions.

PLANETS AND PLANETARY OBSERVATIONS.—In the first of a series of articles on "Planets and Planetary Observation" which he is contributing to the *Observatory*, Mr. Denning discusses the general problems to be attacked and also the instrumental equipment necessary for the work. After discussing the relative merits of refractors and reflectors, he points out that no amateur observer should be discouraged because he possesses only a relatively small instrument, and states that none of the largest telescopes yet employed in this branch of astronomy shows anything beyond what is readily distinguishable in an 8-inch glass.

THE SANITARY CONGRESS AT BRISTOL.

THE twenty-third Congress of the Royal Sanitary Institute was held at Bristol during the week ending July 14. Sir Edward Fry presided. The proceedings of the congress comprised the usual general meetings; meetings in three sections, (1) sanitary science and preventive medicine, (2) engineering and architecture, (3) physics, chemistry, and biology; and meetings of conferences of various classes of persons interested in sanitary science. This year there were conferences of municipal representatives, under the presidency of Councillor Colston Wintle, chairman of the health committee of the City of Bristol, who took a prominent part in the proceedings of the congress; of medical officers of health, under Dr. D. S. Davies, medical officer of health, Bristol; of engineers and surveyors to county and other sanitary authorities, under Mr. H. Percy Boulnois, of the Local Government Board; of veterinary inspectors, under Mr. Frank Leigh; of sanitary inspectors, under Mr. A. E. Hudson, chief sanitary inspector, Cheltenham; of women on hygiene, under Miss Mary Clifford, in the absence of the Duchess of Beaufort; and also a conference on the hygiene of school life, under the presidency of the Bishop of Hereford.

In the presidential address to the congress on Monday, July 9, Sir Edward Fry dealt clearly and concisely with the general history of sanitary works and the regulation of public health. After pointing out the increase of duties and responsibilities which had devolved upon the heads of modern households and upon local authorities in consequence of the recent developments of sanitary science, he referred in turn to the sanitary ordinances of the Greeks, the Jews, and the Romans up to the disappearance of all thought of sanitary science in the ruin of the Western Empire. Finally, he referred to the legislation on the subject in Great Britain since the middle of last century.

Sir W. J. Collins, president of Section I., sanitary science and preventive medicine, was detained in London by urgent parliamentary duties, and the address was read by Dr. Shingleton Smith. It protested against the too exclusive consideration of bacteriology, and appealed for greater attention to be paid to the soil in which bacteria are implanted, and upon which they depend for their development. In Section II., engineering and architecture, the president, Mr. Edwin T. Hall, referred to a number of points in which the architect could assist the promotion of sanitation by the design of buildings. Dr. W. N. Shaw, president of Section III., physics, chemistry, and biology, took for his subject climate and health. After referring to the work of Sir Arthur Mitchell, Dr. Buchan, and Dr. Longstaff, he indicated the climatological material available for the study of questions upon the relation of health to climate, and discussed the methods of using it. In the course of the address he showed a meteorological section of the British Isles from north to south, Sumburgh Head to Hastings, and another from west to east, Valencia to Margate. He also exhibited some interesting diagrams of the average diurnal variation of relative humidity for certain selected months at four observatories in the United Kingdom, and some autographic records of the same element at Cambridge, showing remarkable fluctuations of humidity within the period of twenty-four hours.

The subjects of the addresses at the various conferences and of the papers and discussions were for the most part of a technical character. Questions concerning milk supply and its regulation were raised in Section I. by Dr. J. Fortescue-Brickdale and by Mrs. C. Hamer Jackson, at the conference of medical officers of health by Prof. H. Kenwood, and at the conference of veterinary inspectors by Dr. W. G. Savage and by Mr. J. S. Lloyd. The question of dust, particularly of motor dust, also came up in various forms. In the conference of engineers it was raised by a paper by Mr. A. P. I. Cotterell, and in Section III. the influence of dust on health was a subject of discussion opened by Dr. P. Boobbyer. Of the suggestions made for dealing with the question, some of them could only be called fantastic. The discussion of various aspects of the bacterial treatment of sewage also found a place in several sections or conferences. The necessity for the extension of

employment of women as health visitors or in other ways in connection with the carrying out of provisions for public health also appeared on more than one occasion.

Subjects to be treated from the more specially scientific standpoint fall, as a rule, to Section I., sanitary science and preventive medicine, or to Section III., physics, chemistry, and biology. In the former, Fleet-Surgeon Bassett-Smith suggested various ways in which disease might be disseminated in a paper on present knowledge of the etiology of Mediterranean fever, with special reference to the Royal Navy. The other papers were by Dr. R. S. Marsden, on scarlatina and certain other diseases in relation to temperature and rainfall; by Dr. J. Fletcher, on post-scarlatina diphtheria and its prevention; and by Dr. F. T. Bond, on some points of interest in the treatment of outbreaks of diphtheria. In Section III., besides the discussion on the influence of dust, may be mentioned a paper by Prof. M. Travers, F.R.S., on the absorption of gases in solids, which showed how, following the analogy of the absorption of carbonic anhydride by carbon, the absorption of water vapour by wool and by cotton varied with the pressure of the vapour up to saturation point, and also how the absorption of water vapour by cotton at the same pressure diminished with increase of temperature.

Mr. J. H. Johnston described some experiments upon the determination of the amount of organic colloids in sewage and their partial removal by surface action. Mr. J. W. Lovibond sought for a more precise chemical definition of "pure beer," and indicated the use of his tintometer to identify the quality of beers. Dr. Rideal described the effect of copper sulphate in preventing the growth of algæ in water supplies, and proposed the use of electrolytic chlorine for the purpose. The other papers were of a technical character.

In an evening lecture Prof. Lloyd Morgan set forth very clearly the distinction to be drawn between the deterioration of the individuals composing a race and the degeneration of the stock, and dealt with the bearing of the theory of evolution upon the question of degeneration. A popular evening lecture was also given by Baillie Anderson, of Glasgow, on the wastage of human life.

Ample provision was made for the entertainment of those attending the congress by visits to works and institutions in the neighbourhood, as well as by garden-parties or excursions to the numerous places of interest in the district. The excellence of the arrangements and the smoothness of the working were effective testimony to the admirable organisation of the congress as carried out by a local committee with Councillor Colston Wintle as chairman and Mr. T. J. Moss-Flower as secretary, in conjunction with the officers of the Sanitary Institute, of whom Colonel Lane Notter is chairman of council, Mr. W. Whittaker, F.R.S., chairman of the congress committee, and Mr. E. White-Wallis secretary.

MIGRATIONS INTO NEARER AND FURTHER INDIA.[1]

IT was philologists who first borrowed the name "Dravidian" from Sanskrit and applied it to a well-known family of languages, mostly spoken in southern India, but of which an interesting member, Brâhûî, is found far to the north-west, in Baluchistan. In the hills of Central India, to the north of the main Dravidian group, there is another and totally distinct family of languages which philologists call "Mundâ."

It happens that the speakers of the south-Indian Dravidian languages and the speakers of Mundâ languages possess a common ethnic type—nose thick and broad, low facial angle, thick lips, wide, fleshy face, low stature, figure squat and sturdy, skin dark, and so on. This ethnic type ethnologists have called "Dravidian," an unfortunate piece of nomenclature, for (1) if language can ever be taken as a criterion of race, speakers of Mundâ languages are certainly different in racial origin from the speakers of Dravidian, and (2) *some* speakers of Dravidian languages, the Brâhûîs, do not possess the so-called Dravidian ethnic type, but possess that of the Iranians. At any rate, if we put the Brâhûîs out of consideration for the present, it is better to name the ethnic type "Mundâ-Dravidian," *i.e.* the type common to the people known as Mundâs and to the people known as "South-Indian Dravidians." The type is almost certainly a mixed one. Judging from the fact that all Mundâs possess it, and that it is not possessed by all Dravidians (witness the Brâhûîs), the probability is that the Mundâ-Dravidian ethnic type belongs mainly to the Mundâs, and has been acquired through intermarriage by Dravidians originally endowed with a less persistent type.

When the Aryans entered India they found it inhabited by people of the Mundâ-Dravidian type. The Aryans were the more highly civilised, but as they migrated further and further into the country they intermarried with the people, and themselves commenced to acquire their physical characteristics while they retained their own language and customs, which they in turn imposed upon the Mundâ-Dravidas with whom they came in contact. We see traces of the same interchange occurring even at the present day between the Dravidians and the Mundâs. The Nahâls of the Mahâdêo Hills were once a Mundâ tribe. They came into contact with the relatively more civilised Dravidians, and adopted a mixed speech in which Dravidian predominated. Nowadays this tribe is coming under Aryan influence, and is adopting an Aryan language.

It is impossible to say whether the Mundâs or the Dravidians, or both, were aborigines of India or not. Assuming that the Dravidians were immigrants, the probability is that they entered the country from the south, and not from the north-west, as was maintained by Caldwell and others. Relationship has been alleged, with some appearance of truth, between the Dravidian languages and those of New Guinea and Australia. This subject has not yet been thoroughly gone into, and is at present under examination, but the above seems to be the conclusion which will most probably be reached.

As for the Mundâs, if they were immigrants, they must certainly have entered India proper from the north-east. Pater Schmidt, of Vienna, who attacked the question from without, and the Linguistic Survey of India, which has approached it from within, have arrived at the same result. There was once a race spread widely over Further India of which we find remains amongst the forest tribes of Malacca, in Pegu and Indo-China, and along the Mé-kong and Middle Salwîn. The languages which they speak are members of what is known as the Môn-Khmêr family. Forms of speech closely connected with Môn-Khmêr are Nicobarese, Khasi (spoken in the central hills of Assam), and the various Mundâ tongues of India proper. That there is an ultimate connection between these widely separated languages must now be taken as firmly established by the latest researches of comparative philology. The matter admits of no further doubt. But this is not the limit of the discoveries. The languages of the Himalaya are, it is well known, Tibeto-Burman in character. Nevertheless, there are dialects spoken on the southern slope of these mountains, from Kanâwar in the Punjab almost to Darjeeling, which have a basis similar to this old Mundâ-Nicobar-Môn-Khmêr-Khasi language, that has been, so to speak, overwhelmed, but not entirely hidden, by a layer of Tibeto-Burman. Then, on the other side, Pater Schmidt has shown an intimate connection between Môn-Khmêr and the languages of the south-eastern Pacific, so that there is evidence to show the existence in very early times of a people and a group of speeches extending from the Punjab right across northern India and Assam down to the extreme south of Further India and Indo-China, and thence across Indonesia, Melanesia, and Polynesia up to Easter Island, which is not so very far from the coast of South America.

In India, Nearer and Further, the fate of these speeches has been the same. In Nearer India the Mundâ languages, which were certainly once spoken in the northern plains, have been driven to the hills by Dravidians or Aryans. In Assam and Burmah the Khasis and Môn-Khmêrs have been either driven to the hills, where they survive as islands in a sea of alien tongues, or else to the coast of Pegu by the Tibeto-Burmans, and in Indo-China the Môn-Khmêrs have again been driven to the sea-board by the Tais.

[1] Extension of part of a paper on "The Languages of India and the Linguistic Survey," read before the Society of Arts on March 15 by Dr. G. A. Grierson.

The earliest seat of the Tibeto-Burmans seems to have been the head-waters of the Yang-tse-kiang. From here they migrated in successive waves along the valleys of the great rivers of eastern India, the Salwîn, the Irrawaddy, the Chindwin, and the Brahmaputra. The first three led them to Burmah, which they conquered, and where they founded a comparatively stable kingdom. Down the Brahmaputra they entered Assam, peopling the river valleys and the mountains in successive waves, failing only to occupy the Khasi Hills. Some of those who had entered Burmah settled in the Chin Hills, and, finding no room for expansion, were forced into becoming a backwash to the north, entering Assam from the south—tribe after tribe, in raid after raid—until the migration was stopped by the strong arm of British authority. Other Tibeto-Burmans went up the Brahmaputra into Tibet, which they peopled, getting as far west as Baltistan and Ladakh, and also occupying the Himalaya between Tibet and India proper. It was here that they found and partly gave their speech to the Mundâ-Môn-Khmêr tribes already mentioned.

The most recent Indo-Chinese immigration was that of the Tais. They first appear in history in Yunnan, and thence they began to occupy Upper Burmah some two thousand years ago. A great wave of immigration occurred in the sixth century A.D. Not only did they effectively conquer Upper Burmah, but they invaded Assam. They peopled the Shan States, and in the fourteenth century established themselves in the delta of the Mé-nam, driving the Môn-Khmêrs before them so as to form a Tai wedge between those of Tenasserim and those of Cambodia. This was the foundation of the Tai (or Thai) kingdom of Siam. At the present day the Tais are represented in British India by the Shans, the Khamtis, and other tribes of north Burmah and Assam.

A few words may be devoted to the latest great migration into India proper, that of the Aryans from the north-west. We cannot tell when this commenced. All that we can say is that parts of their earliest literary record, the Vêda, which was composed in the Punjab, have been considered by competent scholars to date from so far back as B.C. 2000, while others date them a thousand years later. The main line of approach was over the most western passes of the Hindu Kush, and along the valley of the Kabul River into the Punjab. Thence they spread over northern India. The entry into the Punjab was a very gradual one, extending over centuries. When the latest comers arrived they found that the language and the customs of their earliest predecessors had developed to such an extent that the former was unintelligible, and the latter were unsympathetic to them. This is reflected in the condition of the Aryan languages of India from the earliest times to the present day. There have always been two sharply differentiated groups of Indo-Aryan languages, one representing the speech of the earliest invaders, and the other that of the latest, while between the two there is a band of intermediate forms of speech which can be referred to the dialects spoken by those who were neither first nor last.

Some Aryan hordes entered the western Punjab from the Pamirs directly to the north. Most of these settled *en route* in the country round Gilgit, Kashmir, Chitral, and in Kâfiristân. Here the inhospitable character of the mountains in which they took up their abode, and their own savage nature, hindered communication with their cousins in the plains, and their customs and language developed on independent lines. The latter presents extremely archaic features. Words which were used three thousand years ago in India proper, and which have since fallen into disuse in that country, have been preserved by it almost letter for letter. These Aryans from the Pamirs have lately been identified with the Pisâchas or "Ὰμοφάγοι," who in later years became the subject of legend, and were looked upon, in the time of Sanskrit literature, as a race of demons.

RESEARCH IN TERRESTRIAL MAGNETISM.[1]

THE Department of Research in Terrestrial Magnetism of the Carnegie Institution, if we may judge from its report for 1905, does not intend to let the grass grow under its feet. The work it has on hand at present comprises, *inter alia*, an examination, partly theoretical, by Dr. Bauer into the secular variation of terrestrial magnetism, a discussion of magnetic disturbances observed during the eruption of Mont Pelée, a general study of the laws of the diurnal variation, a special investigation into magnetic storms, and a discussion of magnetic observations made during the eclipse of the sun on August 30, 1905.

In some researches the cooperation of eminent foreigners has been secured. The investigation into magnetic storms, for example, is being prosecuted under the direction of Dr. Ad. Schmidt, of Potsdam. The scheme, however, which figures most largely on the programme for the immediate future is a magnetic survey of the North Pacific Ocean. Arrangements have been made for observations in countries adjacent to it, *e.g.* China, and a wooden sailing vessel, the brig *Galilee*, has been specially adapted for work at sea. The brig, of which a general idea will be obtained from the picture here reproduced, is of about 600 tons, and carries a crew of eleven in addition to magnetic observers. The bridge shown between the masts is intended to supply a specially favourable site for magnetic observations. The vessel has already made preliminary trips which are considered satisfactory.

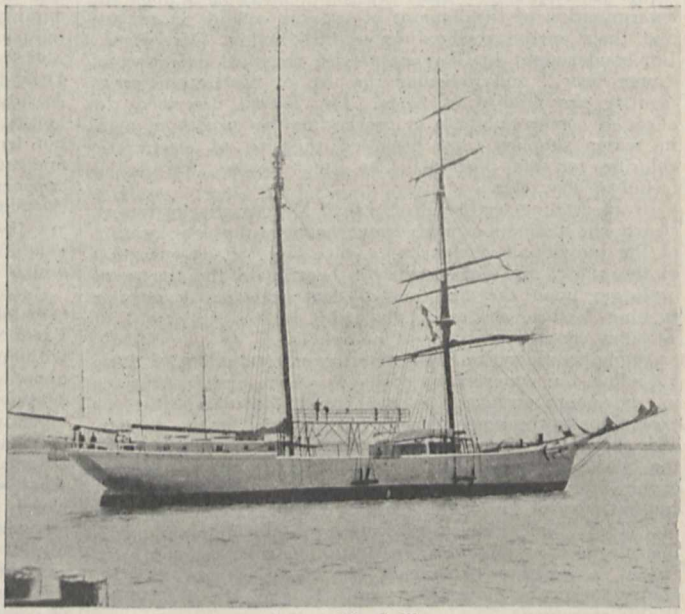

FIG. 1.—The *Galilee*.

The survey of the Pacific is primarily intended to furnish data for researches in which Dr. Bauer is interested, but the results should also be of immediate practical use in the improvement of charts. In addition to terrestrial magnetism, the department is providing for work in atmospheric electricity, and cooperation is intended with the new solar observatory of the Carnegie Institution, near Los Angeles, in studying the correlation between solar phenomena and terrestrial magnetism. With the financial support which the department enjoys, it may look forward to an important sphere of usefulness, especially if it concentrates its efforts, and prefers substantiality to rapidity of achievement.

There are other institutions in America, *e.g.* the Coast

[1] Report of Department of Research in Terrestrial Magnetism, by L. A. Bauer, Director. Extracted from the Fourth Year-book of the Carnegie Institution of Washington. (Washington, D.C., 1906.)

and Geodetic Survey and the Weather Bureau, the lines of research of which, existing or proposed, do not seem wholly distinct from those indicated in the programme. Even European magneticians might feel some slight uneasiness lest a department of so novel a kind, and displaying such unusual readiness to "pay the piper," might not display a corresponding proclivity to "call the tune." One can thus understand the occasion for the director's assurance that the general policy of the department is "not to supplant any existing organisation . . . but rather to supplement and to cooperate in the most effective manner."

REPORT UPON THE CALIFORNIAN EARTHQUAKE OF APRIL 18.

A PRELIMINARY report of the commission appointed by the Governor of California on April 21 to obtain information concerning the earthquake of April 18 has reached us. The commission includes Prof. A. C. Lawson, State University of California, chairman; Prof. G. K. Gilbert, U.S. Geological Survey; Prof. Fielding Reid, Johns Hopkins University; Prof. J. C. Branner, Stanford University; Profs. A. O. Leuschner and George Davidson, State University; Prof. C. Burkhalter, Chabot Observatory; and Prof. W. W. Campbell, director of the Lick Observatory.

The scope of the work of the commission in its preliminary stages embraced the questions as to the origin, position, and character of the disturbance in the earth's crust which gave rise to the Californian earthquake. Having decided upon the scope of its work, the commission appointed three subcommittees to deal respectively with isoseismals, coseismals, and the geophysics of the earthquake. The cooperation of the San Francisco branch of the American Association of Civil Engineers was secured, and the work of its members greatly simplified the collection of data.

The committee on coseismals, being concerned with the records of times at which the earthquake was felt, had to depend largely upon correspondence for information, and for times automatically registered the committee is indebted to seismologists in many countries. Numerous other observations were supplied by officers in the various public services. The committee on isoseismals has also received assistance from many sources.

Subjoined is a summary of the chief results obtained up to the present.

One of the remarkable features of the Coast Ranges of California is a line of peculiar geomorphic expression which extends obliquely across the entire width of the mountainous belt from Mendocino County to Riverside County. The peculiarity of the surface features along this line lies in the fact that they are not due, as nearly all the other features of the mountains are, to atmospheric and stream erosion of the uplifted mass which constitutes the mountains, but have been formed by a dislocation of the earth's crust, or rather a series of such dislocations, in time past, with a differential movement of the parts on either side of the plane of rupture. In general, this line follows a system of long, narrow valleys, or where it passes through wide valleys it lies close to the base of the confining hills, and these have a very straight trend; in some places, however, it passes over mountain ridges, usually, at the divide separating the ends of two valleys; it even in some cases goes over a spur or shoulder of a mountain. Along this line are very commonly found abrupt changes in the normal slope of the valley sides giving rise to what are technically known as scarps. These scarps have the appearance of low, precipitous walls, which have been usually softened and rounded somewhat by the action of the weather. Small basins or ponds, many having no outlet, and some containing saline water, are of fairly frequent occurrence, and they usually lie at the base of the small scarps. Trough-like depressions also occur, bounded on both sides by scarps. These troughs and basins can only be explained as due to an actual subsidence of the ground, to an uplift of the ground on one side or the other, or on both sides. The scarps similarly can only be ascribed to a rupture of the earth with a relative vertical displacement along the rupture plane. Frequently small knolls or sharp little ridges are found to characterise this line, and these are bounded on one side by a softened scarp and separated from the normal slope of the valley side by a line of depression. In many cases these features have been so modified and toned down by atmospheric attack that only the expert eye can recognise their abnormal character; but where their line traverses the more desert parts of the coast range, as, for example, in the Carissa Plains, they are well known to the people of the country, and the aggregate of the features is commonly referred to as the "earthquake crack."

This line, which can be traced from Point Arena to Mount Pinos, in Ventura County, has a length of 375 miles, is remarkably straight, and cuts obliquely across the entire breadth of the Coast Ranges. To the south of Mount Pinos the line either bends to the eastward, following the general curvature of the ranges, or is paralleled by a similar line offset from it *en echelon*; for similar features are reported at the Tejon Pass, and traceable thence, though less continuously, across the Mojave Desert to Cajon Pass and beyond this to San Jacinto and the south-east border of the Colorado Desert. The probability is that there are two such lines, and that the main line traced from Point Arena to Mount Pinos is continued with the same general straight trend past San Fernando and along the base of the remarkably even fault scarp at the foot of which lies Lake Elsinore. But, leaving the southern extension of the line out of consideration as somewhat debatable, we have a very remarkable physiographic line extending from Point Arena to Mount Pinos which affords every evidence of having been in past time a rift, or line of dislocation, of the earth's crust, and of recurrent differential movement along the plane of rupture. The movements which have taken place along this line extend far back into the Quaternary period, as indicated by the major, well-degraded fault scarps and their associated valleys; but they have also occurred in quite recent times, as is indicated by the minor and still undegraded scarps. Probably every movement on this line produced an earthquake, the severity of which was proportionate to the amount of movement.

The cause of these movements in general terms is that stresses are generated in the earth's crust which accumulate until they exceed the strength of the rocks composing the crust, and they find a relief in a sudden rupture. This establishes the plane of dislocation in the first instance, and in future movements the stresses have only to accumulate to the point of overcoming the friction on that plane and any cementation that may have been effected in the intervals between movements.

The earthquake of April 18 was due to one of these movements. The extent of the rift upon which the movement of that date took place is at the time of writing not fully known. It is, however, known from direct field observations that it extends certainly from the mouth of Alder Creek, near Point Arena, to the vicinity of San Juan, in San Benito County, a distance of about 185 miles. The destruction at Petrolia and Ferndale, in Humboldt County, indicates that the movement on the rift extended at least as far as Cape Mendocino, though whether the rift lies inland or off-shore remains as yet a matter of inquiry. Adding the inferred extension of the movement to its observed extent gives us a total length of about 300 miles. The general trend of this line is about N. 35° W., but in Sonoma and Mendocino counties it appears to have a slight concavity to the north-east, and if this curvature be maintained in its path beneath the waters of the Pacific it would pass very close to, and possibly inside of, Capes Gordo and Mendocino. Along the 185 miles of this rift where movement has actually been observed, the displacement has been chiefly horizontal on a nearly vertical plane, and the country to the south-west of the rift has moved north-westerly relatively to the country on the north-east of the rift. By this it is not intended to imply that the north-east side was passive and the south-west side active in the movement. Most probably the two sides moved in opposite directions. The evidence of the rupture and of the differential movement along the line of rift is very

clear and unequivocal. The surface soil presents a continuous furrow generally several feet wide with transverse cracks which show very plainly the effort of torsion within the zone of the movement. All fences, roads, stream courses, pipe lines, dams, conduits, and property lines which cross the rift are dislocated. The amount of dislocation varies. In several instances observed it does not exceed 6 feet. A more common measurement is 8 feet to 10 feet. In some cases as much as 15 feet or 16 feet of horizontal displacement has been observed, while in one case a roadway was found to have been differentially moved 20 feet. Probably the mean value for the amount of horizontal displacement along the rift line is about 10 feet, and the variations from this are due to local causes, such as drag of the mantle of soil upon the rocks, or the excessive movement of soft incoherent deposits. Besides this general horizontal displacement of about 10 feet, there is observable in Sonoma and Mendocino counties a differential vertical movement not exceeding 4 feet, so far as at present known, whereby the south-west side of the rift was raised relatively to the north-east side, so as to present a low scarp facing the north-east. This vertical movement diminishes to the south-east along the rift line, and in San Mateo County is scarcely, if at all, observable. Still farther south there are suggestions that this movement may have been in the reverse direction, but this needs further field study.

As a consequence of the movement, it is probable that the latitudes and longitudes of all points in the Coast Ranges have been permanently changed a few feet, and that the stations occupied by the Coast and Geodetic Survey in their triangulation work have been changed in position. It is hoped that a reoccupation of some of these stations by the Coast and Geodetic Survey may contribute data to the final estimate of the amount of movement.

The great length of the rift upon which movement has occurred makes this earthquake unique. Such length implies great depth of rupture, and the study of the question of depth will, it is believed, contribute much to current geophysical conceptions.

The time of the beginning of the earthquake as recorded in the observatory at Berkeley was 5h. 12m. 6s. a.m., Pacific standard time. The end of the shock was 5h. 13m. 11s. a.m., the duration being 1m. 5s. Within an hour of the main shock twelve minor shocks were observed by Mr. S. Albrecht, of the observatory, and their time accurately noted. Before 6h. 52m. p.m. of the same day thirty-one shocks were noted in addition to the main disturbance. These minor shocks continued for many days after April 18, and in this respect the earthquake accords in behaviour with other notable earthquakes in the past. The minor shocks which succeed the main one are interpreted generally as due to subordinate adjustments of the earth's crust in the tendency to reach equilibrium after the chief movement.

The destructive effects of the earthquake are in the main distributed with reference to the line of rift. The exact limits of the area of destruction have not yet been mapped, but it is known to extend out about twenty-five or possibly thirty miles on either side of the rift. On the south-west side the greater part of this area to the north of the Golden Gate lies in the Pacific. This area extends from Eureka, in Humboldt County, to the southern extremity of Fresno County, a distance of about 400 miles.

Beyond this area of destructive shock the earthquake was felt in its milder manifestations over a wide territory. Our reports to date show that it was felt in Oregon as far north as Coos Bay, and on the south as far as Los Angeles. To the east it was felt over the greater part of middle California and eastern Nevada, particularly along the eastern flank of the Sierra Nevada. It was felt at Lovelocks, and we have unconfirmed reports of its having been felt at Winnemucca. Far beyond the region within which it was apparent to the senses, however, the earth wave was propagated both through the earth and around its periphery, and some of the most valuable and most accurate records of the disturbance which we have are those which were registered at such distant seismographic stations as Washington, D.C.; Sitka, Alaska; Potsdam, Germany; and Tokyo, Japan.

Within the area of destructive effects, approximately 400 miles by 50 miles in extent, the intensity varied greatly. There was a maximum immediately on the rift line. Water pipes, conduits, and bridges crossing this line were rent asunder. Trees were uprooted and thrown to the ground in large numbers. Some trees were snapped off, leaving their stumps standing, and others were split from the roots up. Buildings and other structures were in general violently thrown and otherwise wrecked, though some escaped with but slight damage. Fissures opened in the earth and closed again, and in one case reported a cow was engulfed. A second line of maximum destruction lies along the floor of the valley system of which the Bay of San Francisco is the most notable feature, and particularly in the Santa Rosa and Santa Clara valleys. Santa Rosa, situated twenty miles from the rift, was the most severely shaken town in the State, and suffered the greatest disaster relatively to its population and extent. Healdsburg suffered to a nearly similar degree. San José, situated thirteen miles, and Agnews, about twelve miles, from the rift, are next in the order of severity. Stanford University, seven miles from the rift, is probably to be placed in the same category. All of these places are situated on the valley floor, and are underlain to a considerable depth by loose or but slightly coherent geological formations, and their position strongly suggests that the earth waves as propagated by such formations are much more destructive than the waves which are propagated by the firmer and highly elastic rocks of the adjoining hill lands.

One of the lessons of the earthquake which seems peculiarly impressive is the necessity for studying carefully the site of proposed costly public buildings where large numbers of people are likely to be congregated. In so far as possible such sites should be selected on slopes upon which sound rock foundation can be reached. It is probably in large measure due to the fact of their having such a rock foundation that the buildings of the State University, at Berkeley, escaped practically uninjured.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

PROF. DOELTZ, privatdocent for metallurgy in the Bergakademie in Klausthal, has been appointed professor of metallurgy in the Charlottenburg Technical High School in succession to Geheimrat Weeren, and will enter on his new duties on October 1.

THE council of the University of Birmingham has approved of a scheme for the foundation of a department of economic zoology, and has appointed Mr. Walter E. Collinge the special lecturer on that subject. By this arrangement, Mr. Collinge will vacate his lectureship in zoology and comparative anatomy, and take over the new department at premises at present being fitted up at 55 Newhall Street. These comprise an inquiry office, consultation room, research laboratory, and museum.

ONE of the most satisfactory features of American university education is the keen interest shown by old students in their respective colleges. We learn from *Science* that at the recent alumni meeting at Harvard University it was stated that during the year graduates had contributed about 360,310*l.* to the productive funds of the University, and that 17,623*l.* had been received for immediate use. This sum does not include the more than 22,600*l.* that the class of one year has given to the University to be used as the corporation sees fit. An anonymous gift of 12,000*l.* from a graduate was also announced. Another instance of the same enthusiasm is shown by President Hadley's announcement at the Yale alumni dinner that the total of the alumni fund for the year amounted to 25,847*l.*, as compared with the 10,700*l.* announced a year ago. From our contemporary we also learn that a fund of 30,000*l.*, of which Mr. Carnegie contributed 15,000*l.*, has been raised at Amherst College, and will be used to provide for the work in geology and biology. Mrs. Louisa N. Bullard, too, has given Harvard University Medical School 10,400*l.* to establish a chair of neuropathology.

MR. HALDANE, Secretary of State for War, distributed the prizes on July 13 to the students and nursing pro-

bationers of the London Hospital and Medical College. During the course of an address he delivered subsequently, he said the surgeon, the physician, the nurse, require science to-day in a way in which they never required it before, and science has influenced and affected profoundly their whole teaching. That is why the standards of a generation ago are no good to us, and why any dealing, not merely with the physical organism, but with the great organism of the community, is so much more difficult and far-reaching than used to be the case. Those who are responsible for dealing with the organisation of society know, or ought to know, that unless they have clear principles and plain ends before their minds they can make no advance, and they require economic science, and legislative science, and science of different kinds before they can get those views in a definite fashion. They would do well, Mr. Haldane continued, to take a lesson from the science of medicine, which has taught that the healing of the body is absolutely dependent on the understanding of the principles upon which life is governed. There are new ideas which penetrate deeper and deeper as year succeeds year. To-day we know that science is the guiding star of work. It is in such men and women as those studying in medical colleges that we have the hope of the future, the security that the story of our race may yet be a story of progress, and that in the generation to come we may see yet a higher state of things realised than even that which we have realised at the beginning of the twentieth century.

THE new buildings of Armstrong College, Newcastle-on-Tyne, described in NATURE of July 5 (p. 232), were opened by the King, who was accompanied by Queen Alexandra, on July 11, in the presence of a large and representative assembly. Addresses to the King were presented by the governors and council of the college, the professors, and the students. In the first-named the president referred to the electrical engineering laboratories, and stated that it is desired to bring this department to as high a level as that of the mechanical engineering of which the college is so justly proud. The liberality of the shipbuilders of the district, it was added, is now being exercised in the establishment of a school of naval architecture befitting the north-east coast as one of the chief seats in the world of the shipbuilding industry. In the course of his replies, the King expressed his admiration of the magnificent buildings; he commended the wisdom of adapting the teaching of the college to the practical needs of the students, and, in mentioning the name of Armstrong as identified with scientific discovery and industrial success, stated that scientific principles are now more than ever necessary for the mental training of all who hope for success in the great engineering works for which Newcastle is famous all the world over. The Earl of Carlisle presented the Queen with a casket made on the premises by the Newcastle Handicrafts Company, a practical offshoot of the art department of the college. Afterwards the Dean of Durham and Mrs. Kitchin, Sir Isambard and Lady Owen, attended their Majesties in a visit to the electrical engineering laboratory, where Prof. Thornton had arranged several interesting demonstrations.

THE summer meeting of the Association of Technical Institutions was opened at Oxford on July 13, with Sir William Anson, president, in the chair. In his presidential address, Sir William Anson said technical associations are comparatively new in our educational system, and an increasing endeavour should be made to accommodate the old to the new, and to find a place for that which is new without dispossessing the old, where that which is old is not worn out, where it combines, as the ancient universities combine, vitality and the promise of the future with the stability which comes of great traditions drawn from the past. The two elder universities are sometimes thought, Sir William Anson continued, to be aloof from the activities of modern life, and Oxford perhaps more so than Cambridge, because of the devotion which Cambridge has always shown to mathematics. Though a university may legitimately specialise in the direction of certain studies, where it can develop those studies in close contact with the operation to which scientific investigation is applied, it ought never to forgo the general scientific teaching which is an essential feature of a university course. What is the relation of the universities to the work of the technical institutes, which, in one form or another, form such a prominent feature in the educational system of municipalities? Sir William Anson thinks it is twofold. In the lower stages the schools of science and technical institutes attended by boys may give such a training as will qualify for scholarships at the universities, and the universities, being thus the goal of the technical institute in its more rudimentary form, should be the starting-point for technology in its more advanced form. The man of science may make discoveries which others may utilise, but the student, if not a man of action himself, helps and befriends the man of action, and technology, if it is to go on advancing, must go hand in hand with those studies which every university, however situated, is able to promote.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, July 2.—M. H. Poincaré in the chair.—An addition to the notes of May 21 and June 11 relating to the discontinuity of the specific heats of fluids: E. H. **Amagat.**—The action of sulphuretted hydrogen on some oxides. Applications to volcanic phenomena and hot springs: Armand **Gautier.** At a white heat, sulphuretted hydrogen reacts with both the magnetic oxide and peroxide of iron, giving iron sulphide and a mixture of hydrogen and sulphur dioxide. A small quantity of sulphuric acid is formed simultaneously, even when oxygen is absent. With alumina, sulphuretted hydrogen gives an oxysulphide of aluminium, together with a mixture of the same gases as above. Sulphuretted hydrogen and carbon dioxide at a red heat give carbon oxysulphide, water, carbon monoxide, and hydrogen, the reaction being the same whether the gases are initially dry or wet. The bearing of these experiments on the composition of volcanic gases is pointed out.—The lava produced by the recent eruption of Vesuvius: A. **Lacroix.** The general phenomena characterising the recent eruption have been described in earlier papers; in the present note the composition of the products corresponding to each phase of the eruption has been studied.—The earthquake in California according to the preliminary official report: A. **de Lapparent.** The evidence is distinctly against the view which has been put forward that there is any connection between the earthquake and volcanic phenomena. The Californian earthquake was essentially an orogenic phenomenon, there being signs of dislocation for a distance of more than 600 kilometres along the Californian coast. The connection between the damage done to buildings and the nature of the soil upon which they were built has also been clearly brought out by the preliminary investigations.—Some synthetical reactions of pinacoline: Louis **Henry.** A study of the products of the reactions between pinacoline and magnesium-methyl bromide and hydrocyanic acid. Both the reactions are normal.—Families of Lamé with plane trajectories, the planes passing through a fixed point: S. **Carrus.**—H. C. Vogel was elected a correspondant for the section of astronomy in the place of the late Prof. Langley.—The classification of irrationals: Ed. **Maillet.**—Researches on armoured concrete and the influence of the removal of the charge: F. **Schüle.**—The influence of surface tension on the propagation of waves parallel to the surface of a liquid plate: M. **Alliaume.**—An optical arrangement generalising the use of the telescope of 1 metre diameter at the Observatory of Meudon: G. **Millochau.** The arrangement consists of an objective of three divergent lenses, placed between the telescope mirror and its focus. By varying the position of the lenses, images can be obtained having the dimensions of those which would be produced by a mirror of a metre diameter and a focal distance capable of variation from 15 metres to 25 metres.—The colorations of fringes localised in a thin plate limited by a grating: Georges **Meslin.**—Phosphorus chloronitride: MM. **Besson** and **Rosset.** An advantageous method of preparing this substance is described, and details given of its reactions with

water, ozone, sulphur trioxide, and nitrogen peroxide.—The isomorphism of mercuric iodide with the iodides of zinc and cadmium: A. **Dubois.** Iodide of mercury is capable of crystallising in all proportions with the iodides of zinc and cadmium.—The non-existence of phosphorus trisulphide: R. **Boulouch.** Definite sulphides of phosphorus having formulæ between P_4S_3 and P_3S_5 do not exist, and the latter is not necessarily a definite compound.—The crystallography of iron: F. **Osmond** and G. **Cartaud.**—The determination of the transformation points of some steels by the electrical resistance method: P. **Fournel.** The wire under examination (0·3 mm. diameter) was wound on mica and heated in a vacuum by an electric furnace, the temperature being measured by a thermo-couple, and the resistance measured by the potentiometer method. Previous researches in which the same method was used have only shown clearly the point called A_3 by Osmond. In the present research the additional points A_1 and A_2 were also clearly defined.—The solubility of carbon in calcium carbide: H. Morel **Kahn.** The amount of graphite recoverable from calcium carbide increases with the temperature to which the carbide has been subjected in the presence of an excess of carbon. It also increases with the duration of the heating.—The action of urethane and urea on ethylglyoxylate. A new synthesis of allantoin: L. J. **Simon** and G. **Chavanne.**—The formation of indazyl derivatives starting with *o*-hydrazobenzoic acid: P. **Carré.**—Ethyl dioximidosuccinate: A. **Wahl.**—A mode of reaction of some acid anhydrides: R. **Fosse.**—A new method of estimating casein in cheese: A. **Trillat** and M. **Sauton.** The method is based on the fact that the casein is rendered insoluble by the addition of formaldehyde. Details of the control experiments are given.—The composition of the soils of French Guinea: Alex. **Hébert.**—The malacological fauna of the lakes of Rodolphe, Stéphanie, and Marguerite: R. **Anthony** and H. **Neuville.**—The development of the egg of *Ascaris vitulorum* in an artificial medium: L. **Jammes** and A. **Martin.**—The seminal apparatus of Helix: A. **Popovici-Baznosanu.**—The action of the leguminose on the excretion of uric acid: Pierre **Fauvel.**—The utilisation of carbohydrates in arthritic diabetes: René **Laufer.**—The auto-adaption of abnormal embryos and the tendency to anomaly: Etienne **Rabaud.**—New attempts on the maturation of the egg in *Rana fusca*.—Parthenogenesic segmentation provoked by freezing and distilled water: E. **Bataillon.**—The fundamental unit of the black races: the radio-pelvic index: Louis **Lapicque.**—Fibrillary structure in the Bacteriaceæ: J. **Kunstler** and Ch. **Gineste.**—Thyroid grafts: MM. **Charrin** and **Cristiani.**—Radium in gynæcology: MM. **Oudin** and **Verchere.** Details are given of the use of radium in nine cases, three of which were cured and the remainder improved.

CAPE TOWN.

South African Philosophical Society. March 28.—Dr. J. C. Beattie, president, in the chair.—Morphological research on the surviving members of the ancient group, the cycads: Prof. H. H. W. **Pearson.** The relationship of the group to the Pteridophyta was discussed, and microscopic slides showing (*a*) pollen tubes, (*b*) the ciliated spermatozoid, (*c*) the karyokinesis of the nucleus of the central cell of the archegonium prior to the formation of the canal-cell-nucleus, of *Encephalartos Alstensteinii* were exhibited. A specimen of *Stangeria paradoxa* with an apogeotropic root and a microscopic section showing the endophystic "nostoc" were also shown.—The nature of effect of the sun-spot frequency on the variation of the magnetic elements at the Cape of Good Hope: G. H. H. **Fincham.** By a consideration of Sabine's observations at the Cape of Good Hope obtained in 1842–6, it is shown that the sum of the sun-spot effect on the declination is a maximum in winter; the same result was found for the horizontal intensity.

April 25.—Dr. J. C. Beattie, president, in the chair.—The round perforated stones (tikœ) alleged to have been made by Bushmen for the purpose of giving weight to the "kibi" or digging stick: L. **Peringuey.** That some aborigines, Bushmen or Hottentots, made use of these stones for the aforesaid purpose was now proved. Although Kolben did mention the digging stick as a part of the Hottentot household utensils, he never said anything about the perforated stone being used. Sparrmann, however, does so. Then follows Burchell, who figures the tikœ and the kibi. Livingstone, in his last Journal, gives evidence on the subject, but quotes from memory. In the figures given in that work the stone is a flat disc. That the stones were used for the alleged purpose by some aborigines is, however, made more clear by Bushman paintings, tracings of which were exhibited by permission of Prof. Young, of Johannesburg.

May 30.—Dr. J. C. Beattie, president, in the chair.—Rock etchings of animals, &c., the work of South African aborigines, and their relation to similar ones found in Northern Africa: L. **Peringuey.** These etchings are not uncommon along the Orange River, also the Vaal River, in the Asbestos Mountains, and other parts of the colony, Beaufort West, Clanwilliam, Humansdorp, &c., also in the Transvaal, and the author proceeded to compare these with etchings of a similar nature discovered and reproduced by the Geological Survey of Algeria.—Observations on the functions of the ethereal oils of xerophytic plants: Dr. R. **Marloth.** Since the observations of Tyndall on the great diathermancy of the vapours of ethereal oils, many biologists think that the main function of these oils is to produce a protective atmosphere around the plants, thereby reducing their transpiration. If that were the case, one would expect that the excretion of oils would be largest in the driest season and the hottest part of the day. But just the reverse is the case, for many aromatic plants do not betray their presence at such times, while the atmosphere becomes filled with their aroma during foggy weather. Such plants are many Rutaceæ, Compositæ (wormwood), Umbelliferæ (Bubon), Pelargonium, and even the rhenosterbush. These facts are, however, in perfect accordance with the view that the oils are a protection against the attacks of herbivorous animals, especially also against snails and slugs, which appear only during wet weather.

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