THURSDAY, FEBRUARY 20, 1902.

PLANARIANS AND THEIR ALLIES.

A Treatise on Zoology. Edited by E. Ray Lankester, M.A., LL.D., F.R.S. Part IV. "The Platyhelmia, Mesozoa and Nemertini." By Prof. W. Blaxland Benham, M.A., University of Otago, New Zealand. Pp. iv + 204. (London: A. and C. Black.) Cloth, 15*s.* net; paper covers, 12*s.* 6*d.* net.

IT is a new thing for a whole volume of a zoological treatise to be devoted to the two phyla, Platyhelmia (Turbellaria, liver-flukes and tapeworms) and the Nemertea (long sea-worms), which Prof. Benham describes in the work before us. For a number of reasons they are not popular groups of animals. The free-living forms are delicate and their very identification is attended with considerable difficulty, and needs mechanical skill and anatomical knowledge. The parasitic forms add gruesome associations to these troubles, so that it is only the unfortunate patient, the doctor and the scientific agriculturist who have in any sense a working acquaintance with flukes and tapeworms. Very few zoologists know much about them except in such places as Italy, parts of Germany and Egypt, where their unpleasantly common occurrence has created the necessity for a thorough investigation of the modes of infection and of the methods for obtaining immunity from their attacks. Hence it is that in most text-books these phyla have not been given that serious and thorough attention which is afforded them in Prof. Ray Lankester's "Treatise of Zoology." We have here a compact, lucid and scholarly summary of the anatomy, life-histories and classification of the parasitic flatworms.

With such an unprecedented amount of room at his disposal Prof. Benham would have done well to have brought his opening chapter (on the Turbellaria or Planarians) more up to date in its anatomical, physiological and bionomical aspects. It was written and has been in proof some years, as the editor tells us, but we cannot accept the soothing remark that "the editor is satisfied that no important omissions due to this fact occur in the book." Von Graff's splendid monograph on land-planarians (1899) is barely alluded to, and his striking results on the anatomy and distribution of these animals are omitted, nor are any of his figures introduced. The work by Hesse on the eyes of Turbellaria is merely mentioned, but his important results are passed over in silence. The paper by Dörler (1900) on parasitic Vorticidæ, in many ways a striking piece of work, is entirely overlooked. The application, by Rina Monti, of the "Golgi-method" to the detection of nerve-elements of Planarians (1896, 1900), the work by Prof. E. L. Mark on Polychærus (1892!), the many papers by the school of comparative physiologists and more particularly by Parker and by Prof. Loeb, are a few of the more striking omissions which occur to us. In some of these cases we may excuse Prof. Benham (but not his editor), since his residence in New Zealand may preclude access to the "Zoologische Jahresberichte" of the last four years; but even this allowance cannot cover the lack of information on topics such as colour, distribution and variation, upon which the evidence yielded by Turbellaria is not inconsiderable and is of great and growing interest.

The chapters succeeding that on the Turbellaria are far more satisfactory, though there are several omissions of important or useful papers, such as Looss' work on Egyptian Trematodes and the publications by Dr. Stiles and other members of the Washington Bureau on the parasites of domestic animals. To the student of anatomical zoology the sections on the "cuticle," "parenchyma," and the life-histories and their interpretation, will be a clearer guide to the nature of these problems than can be found in any other text-book.

As to the nature of the cuticle or investing membrane of Trematodes and Cestodes, Prof. Benham concludes from the researches of Blochmann and Kowalewski that the outer part of this structure is a true cuticle secreted by epidermal cells. In the adult parasite, however, these cells no longer form an epithelium, and their true nature is further disguised by the fact that they lose their primitive connection with the cuticle and sink into the parenchyma through the basement-membrane *pari passu* with an outward migration of cells of the parenchyma. These changes are illustrated by an excellent figure from Blochmann's memoir.

From an economic as well as from a strictly zoological standpoint, the interest of Trematodes and Cestodes centres in the life-history, which becomes progressively complicated in each group. There may be in the history of one parasite two successive larval stages passed in different hosts. Each stage is capable of reproducing many generations of its kind and then suddenly giving rise to the later larval form or (in the case of the latter) to the adolescent stage, which grows to maturity in the final host. The distinguishing feature of the process is the power of multiplication of the parasite while it is still a larva, and it is on the nature of this process that difference of opinion exists. The older writers regarded it as an asexual mode of reproduction, as a kind of budding; and they emphasised the alternation of these larval asexual generations with the adult sexual generation. The tendency of modern research has been to regard the larval generations, not as asexual, but as produced by the development of unfertilised eggs, in fact as cases of juvenile parthenogenesis; so that the life-history may on this view be summarised as a series of sexual generations, of which those which occur in the larval stages are parthenogenetic and that which subvenes in the adult worm is either self- or cross-fertilised.

To this modern view Prof. Benham assents, without, however, pointing out the necessity of obtaining critical evidence in its favour. The mature eggs of many animals differ from the body-cells in possessing only half the number of "chromosomes" which characterise the nuclei of the somatic-cells. It ought to be shown whether this holds true of the larval as well as of the adult "eggs" of Trematodes and Cestodes before the view that all the generations are sexual can be considered proved, and it would require still further evidence as to the number of the polar-bodies presumably extruded by the larval eggs before we could accept their parthenogenetic nature as demonstrated.

The concluding chapters on the Mesozoa and Nemertea have been carefully brought up to date. They furnish a trustworthy account of the essential facts of anatomy and development, but as occurs in the case of the other groups described in this volume, the problem of their affinities is not set forth with that clearness which is so essential to its comprehension.

Considered as a whole, the volume has not that illuminating and suggestive value which distinguished the earlier volumes of the "Treatise." Nevertheless it will remain for some time the chief work of reference in the language on the anatomy and classification of the groups with which it deals.

PRIMARY BATTERIES.

Primary Batteries: their Theory, Construction and Use. By W. R. Cooper. Pp. 4+324. (London: *The Electrician* Printing and Publishing Co., Ltd., on date.) Price 10*s*. 6*d*. net.

MR. W. R. COOPER'S book directs attention to a subject which will always be of great historical interest on account of the remarkable stimulus given to electrical science by the discoveries of Galvani and Volta. At the present time, it is true, the primary battery has yielded to cheaper and more convenient sources of electrical energy, and the position which it holds in electrical engineering is comparatively insignificant. It is not improbable that before long it will be displaced from almost all practical applications of electricity and will only be found where the dynamo and accumulator are unavailable. It may, however, be some consolation to those who have not other means at hand to reflect that in the research by which Faraday laid down the fundamental laws of electrolysis he obtained current from a primary battery of the most elementary form. The advantage of amalgamating the zinc had been shown five years earlier (1828) by Kemp, but it was not until 1836 that the first effective depolarising cell, that of Daniell, was described; the invention of the Grove cell followed in 1839. The Leclanché cell, which did not appear until 1868, marks the only other development of the first importance.

In spite of the fact that Volta's discovery is more than a century old, the theory of the primary battery cannot be said to be in a very satisfactory state. Mr. Cooper devotes two chapters to this subject, the first of which deals chiefly with contact-force and the seat of the E.M.F. in the cell. Mr. Cooper, in summing up the various theories, states that "the whole matter (of the seat of the E.M.F.) is largely a question of definition, and is, therefore, of relatively small importance," a conclusion which is not likely to commend itself to those who are anxious to arrive at the truth. In the second chapter, the ionisation theory of Arrhenius is discussed and the calculations of the E.M.F. of a cell from the equations of Helmholtz and Nernst are compared, with results which are not very convincing in either case. The author then passes to a brief consideration of concentration and liquid cells (which are at present only of theoretical interest) and of the thermopile, which, he points out, on account of its high price is not likely to prove a serious competitor to the primary battery.

There follows what may be called the practical part of the book, in which the various types of existing cells are described and which contains much valuable information collected or directly obtained by the author. Cells are classified under three headings, one-fluid, two-fluid and dry cells. In the first division, the principal examples are the bichromate, Leclanché and copper-oxide cells. Some interesting tests carried out by the author show that in the bichromate cell the most suitable depolariser to use is chromic acid, which gives a discharge curve as good as that given by either sodium or potassium bichromate and is also more convenient and as cheap. The two-fluid cells include the Daniell, with its numerous derivatives, and the Grove and Bunsen cells, which on account of their high E.M.F. and low internal resistance are especially suitable where heavy currents are required. All the dry cells are modifications of the Leclanché and do not differ much from one another except in details of construction. It is somewhat surprising to find that, weight for weight, the dry cell is superior to the wet form of Leclanché. Against this must be set the somewhat higher initial cost and the advantage of the possibility of regenerating an exhausted wet cell, though this latter consideration, as Mr. Cooper shows, is in reality somewhat illusory. The usefulness of this part of the book is greatly increased by the numerous discharge curves which are included and by the many very clear drawings illustrating the various cells described.

The last two chapters deal with standard cells and carbon-consuming batteries. The standard cell is, and is likely always to remain, of the highest practical importance; the chapter dealing with it is consequently of great interest and value, as it contains in a convenient form most of the hitherto scattered information on this subject. The table of constants of standard cells shows that the results of recent determinations point to the value 1·433 volts being more nearly correct for the E.M.F. of a Clark cell at 15° C. than the generally accepted (and legal) value of 1·434 volts. The Helmholtz cell, recently modified by Hibbert, is of interest on account of its having an E.M.F. of 1 volt at 15° C. and also a very low temperature coefficient, though in this latter respect it is inferior to the cadmium cell. The final chapter, on the carbon-consuming cell, is, unfortunately, only a record of failures. It would seem as if commercial success, if ever to be achieved, will have to be sought on entirely new lines. But the problem is not likely to lose its fascination so long as the overall efficiency of steam generation remains as low as 6 per cent. whilst the primary battery holds out a prospect of the attainment of an efficiency of 73 per cent. or more. M. S.

A MEMOIR ON MORAINES.

Geschichte der Moränenkunde. Von Dr. August Böhm Edlen von Bömersheim (*Abhandlungen der K. K. Geographischen Gesellschaft in Wien*, iii. Band, No. 4). Pp. viii+334; 4 plates, 2 figures in text. (Wien: R. Lechner, 1901.)

AS to the history of moraines, the author might fairly say "What there is to know, I know it." By patient research in libraries he has collected a great mass of information, of which the present volume is a summary. It also contains, besides the main subject, a full account of drums or drumlins, which in some way or other are closely related to moraines, the proceedings of the Glacier Conference held at Gletsch in August, 1899, a section on the distinctions and nomenclature of moraines, a glossary and list of synonyms, and indices of authors and subjects. After answering, by quotations from writers, beginning with Sebastian Münster in 1544, the question, What is meant by a glacier? he passes on to moraines, which are at first mentioned casually, without any definite name. This does not appear till rather late in the eighteenth century, about the time of De Saussure. The word, no doubt of patois origin, was not admitted to dictionaries or encyclopedias till well on in the following century. According to Littré its origin is unknown, though it evidently is related to the Low Latin *morena*—bank of stones—which also appears in Italian under the older form, *mora*, and in Piedmontese *murena* designates earth piled in a bank by the side of a field. We also learn that in the German Alps the names *Ganda*, *Gandecken*, *Mârenes* and *Murren* are used, the last perhaps restricted to the Œtzthal district. Then follows a long series of abstracts or extracts chronologically arranged from the works of travellers by whom moraines have been noticed or described.

Before the first quarter of the nineteenth century the accounts become definite, von Charpentier in 1819 pointing out that some of the material in a terminal moraine travelled on, some under, the ice. The different varieties are clearly distinguished by F. J. Hugi in 1830, from which time the study assumes a scientific aspect, J. de Charpentier four years later clearly recognising old moraines. They began to be identified in other countries; C. Martins, in 1841, compared the glaciers of Spitzbergen and the Alps, and showed that moraines were also associated with the former. At the same time the study of everything associated with glaciers received a fresh impulse from the investigations of Agassiz, and from this date ground moraine (*grund moräne* or *moraine profonde*) begins to figure in books (though we believe he spoke only of *couche de boue*). Of this, perhaps, not so much is now heard as some quarter of a century ago, when a glacier might have assumed *Diruit*, *Ædificat* as a motto, for it was credited with scooping out a deep lake basin in one place and laying down a thick cushion of "till" in another. The most important additions to knowledge since the valuable summary in Dr. Heim's "Handbuch der Gletscherkunde" (1884) have been Prof. T. C. Chamberlin's observations, completed by his studies in Greenland, that in large glaciers an amount of material, greater than was generally supposed, is transported embedded in the ice (englacial), particularly in the lower part, in which, owing to shearing movements, it often assumes a rude stratification. Thus in certain circumstances, a very remarkable instance of which was described in 1898 by Profs. Garwood and Gregory, materials may even be carried uphill for a certain distance.

Students will find the twenty pages containing a summary of what has been written about drumlins or drums very useful for reference, though whether they will arrive at a clear conviction of how these were formed is less certain. That, however, is the fault of the subject, not of the author, for they are among the greatest puzzles in glacial geology. In America, in some districts of which they seem to be especially well developed, they form oval hills, occasionally as much as a mile in length, their breadth being about two-thirds of this, and they rise, according to their area, from 25 to 200 feet in height. They are composed of similar material to till, with slight or no signs of stratification, and when numerous show a rude parallelism. The principal facts in regard to their structure are generally admitted, but here unanimity ceases.

We owe a debt of gratitude to the author of this work. In such a subject, indeed in any one connected with glaciers, the task of searching through its literature is most laborious, and as the student often finds hypothetical inferences more abundant than careful descriptions of facts, he is tempted to doubt, as did the charity boy when he got to the end of the alphabet, "whether it was worth going through so much to get to so little." This book, with its summaries and useful indices, will enable him to ascertain what observations are on record and what hypotheses have been formulated. He will also find, in the account of the conference in 1899, the latest classifications proposed (in which, we think, over-minute distinctions are attempted), and will be enabled to begin personal investigations with a general knowledge of previous opinions, more than which is apt to be a hindrance rather than an advantage. T. G. B.

CHEMISTRY OF PAINTS.

The Chemistry of Pigments. By E. J. Parry and J. H. Coste. Pp. viii + 280. (London: Scott, Greenwood and Co., 1902.) Price 10*s.* 6*d.* net.

THIS book is divided into four parts or chapters. The first of these, occupying just seventeen pages, deals with the optical origin of colour; the second chapter, entitled the "Application of Pigments," discusses in separate sections their purely artistic uses, their decorative employment and their protective qualities. These sections are followed by descriptions of the methods of applying pigments, including pastel, water-colour, tempera, oil-painting, keramic painting, enamelling, glass and mosaic. Large use is made, in the first of these sections of chapter ii., of Russell and Abney's 1888 report on the "Action of Light on Water-Colours," and in the third section of Mr. Harry Smith's recent experiments on the protection against the rusting of iron afforded by many different kinds of paints. The two chapters which constitute the body of the work before us and occupy a couple of hundred pages are entitled respectively "Inorganic Pigments" and "Organic Pigments." Here we find much information of interest and importance in the actual analyses given of individual samples of different pigments and in the notes on methods of examining and testing pigments. But some pigments, such, for instance, as aureolin and cadmium yellow, are treated too summarily in view of their artistic importance, while to other pigments, notably to the large group of "coal-tar lakes," is assigned a treatment which they do not deserve.

And here the question forces itself upon a reviewer's attention, "For what class of readers has this book been written?" The authors speak in their preface of "those who are called upon to use or examine pigments as a guide to the selection of those which are suitable." If students of art and painters are here meant, we fear that a large part of the information offered for their instruction will be thrown away, for none of them are likely to learn much from such statements as this (p. 258): "The basic colour auramine is imido-tetramethyl-diparadiamido-diphenylmethane." Perhaps, however, Messrs. Parry and Coste intended to address themselves to those who are to "examine pigments" rather than to those using them. If so, the work before us certainly presents, with the limitations of omission and inclusion previously indicated, a convenient compendium of figures and facts. A reasonable critic is averse to making much ado about misprints and mistakes that are akin to misprints, for he knows how provokingly these blots on his work elude the notice even of the really instructed author. But the pages before us seem to be in unusual need of correction. Take these examples: Fraunhofer (pp. 3 and 8) should not have an "e" before the "n," while the "o" ought to be without *umlaut*. It is surely a mistake to attribute to linseed oil a tendency to crack (p. 64). Viridian is the proper form, not vividian and veridian (p. 114). Hydrolised (p. 115) is incorrect. For arsenate (p. 157, line 31) read arsenite. The formula for gambogic acid, $C_{30}H_{35}O_6$ (p. 271), and that for euxanthic acid, $C_{19}H_{18}OH$ (p. 273), are alike impossible. The table of analyses of Indian yellow (p. 274) is incorrectly reproduced from Thorpe's Dictionary. On p. 231 globorus occurs as a specific name.

Quotations from Church's "Chemistry of Paints and Painting" are numerous, but are handsomely acknowledged.

OUR BOOK SHELF.

Handbook of Sanitation. By George M. Price, M.D. Pp. xi + 317. New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1901) Price 6*s*. 6*d*. net.

THE circle of those whose duties compel them to make a special study of sanitary questions is a rapidly widening one in the United States of America, as indeed it is in this country; and one gathers from the author's preface that in spite of the growing number of sanitary inspectors, the still greater number of candidates for inspectorships and the general interest in sanitary questions, there are in America no text-books in which the necessary knowledge is set forth in a concise and suitable form. Of course the sanitary laws and sanitary practice are different in the United States of America, or otherwise we could supply the deficiency from the somewhat extensive literature which exists upon the subject in this country. The general principles of sanitation apply to all countries, but the extent and nature of their application are often determined by legislation of varying character and scope. It is for that reason that many of the English text-books on sanitation are of limited use in America, and that the present volume will only appeal to a few English students.

In part i. of the work a *résumé* is given of sanitary science. The matter is often far too condensed; the important subject of water and water supply is, for instance, dismissed in about seven pages, and in this part, and this part only, there are one or two matters to which exception may be taken:—"Cretinism, as well as goitre, has been traced directly to a certain chemical composition of the soil" (p. 7); the contents of sewers are the breeding-places for various virulent bacteria . . . and constitute a favourable culture-medium for all other disease-causing organisms"; and in Fig. 22 a "washdown" W.C. is described as a "washout" form.

It is curious for us in this country, where iron house-drains are so rare, to read that the house-drain "should be hung on the cellar-wall or ceiling, unless this is impracticable, as when fixtures in the cellar discharge into it."

Part ii. is on sanitary practice. In this part are given the methods of application of sanitary science in various municipal departments, with extracts from the law, rules and regulations of New York and other municipalities. This constitutes the best part of the book, although here again certain matters (food, disinfection, &c.) are far too sketchily dealt with.

Part iii. of the book relates to the inspector, his duties and qualifications; and part iv. contains, besides useful chapters on sanitary law and sanitary organisation in the United States, extracts from model laws on various branches of sanitation.

Advanced Exercises in Practical Physics. By Prof. Arthur Schuster and Dr. C. H. Lees. Pp. x + 368. (Cambridge: University Press, 1901.) Price 8*s*.

IN this book the authors describe some seventy exercises in practical physics suitable for students preparing for a B.Sc. degree. The exercises, therefore, deal with elementary subjects, which are described at considerable length; for the authors attach "greater importance to neat and accurate work, properly recorded, than to the number of experiments which a student performs." The title "Advanced" is here used to mean that the work is to be done in a manner befitting an advanced student rather than that the subjects are illustrative of the higher parts of physics.

The contents of the work are divided into six books. The first book contains preliminary matters, amongst which appears the calibration of the spirit-level, which is generally omitted from text-books, although the instrument is one of frequent use. The second book is devoted to mechanics and general physics, and here we are glad to see twenty-four pages on the balance, for the experience of teachers is that students know, as a rule, very little about this important instrument. In the third book heat is the subject, and special stress is put on the proper study of the cooling corrections in calorimetric experiments. If the methods indicated here are carefully carried out, the student should obtain very satisfactory results in his heat measurements. The fourth book contains sound, and the fifth light. In the latter we have a very full discussion of the spectrometer. Polarisation is introduced in two exercises. The sixth book deals with magnetism and electricity.

It is refreshing to read this text-book, for it is not a mere compilation from others, and the teachers and students who use it will feel that they have a guide written by authors who have thoroughly and exhaustively considered the principles and methods of the experiments they are describing. One of the aims of a text-book must be to add to the convenience of the teacher and student in getting at the groundwork of a subject, and this is eminently done in the one before us. The clearness and logical order of the descriptions will greatly facilitate the student's work, and by its use, supplemented with experimental lectures, we think a wide knowledge of physics from the point of view of the facts will be obtained. The diagrams and illustrations are new and exceptionally well done, and the type and get-up of the book are excellent.

The work can be strongly recommended to teachers in schools as a reference book on practical physics, and to university students for general use in the laboratory.

S. S.

Recherches Expérimentales sur les Spectres d'Étincelles. By G. A. Hemsalech. In three parts. Pp. xvi + 135. (Paris: Libraire Scientifique, A. Hermann, 1901.)

THE author, as an introduction, gives a short historical notice of the investigations on the nature of spark spectra by Wollaston in 1802, Talbot and Wheatstone in 1836, and later those of Masson, Ångström, Kirchhoff, Miller, Huggins, Lockyer, Hartley and Adeney, Eder and Valenta, Exner and Haschek.

The first part of the book is then devoted to a short description of the characteristics of various types of spark, ordinary, intermittent and oscillatory, with the influence of varying self-induction on those of the latter description.

The second part describes in detail the apparatus, electrical and spectroscopic, used in the investigations, with illustrations of typical sparks of the three mentioned classes.

Part iii. is occupied by a series of tables showing the wave-lengths of the lines measured in the spectra of the fourteen metals, Fe, Mn, Ni, Co, Cd, Zn, Mg, Al, Sn, Pb, Bi, Sb, Cu, Ag, with their relative intensities under three degrees of self-induction. The lines in the spectrum of air are also tabulated, showing their varying intensity in the spectra produced by the above metals being used as poles.

The variation of the self-induction is accompanied by different results according to the metals used, and the fourteen elements investigated are divided into two groups, one containing Fe, Mn, Ni, Co, the other the remaining ten metals. With the first group, increase of self-induction produces a general increase of brightness of the constituent spectral lines, while in the second group the intensities of the lines are diminished by increasing the self-induction. The lines due to air may be completely eliminated.

The work, commenced by Schuster and Hemsalech conjointly, has been continued by the present author in the physical laboratory of the Faculty of Sciences of Paris at the Sorbonne. C. P. B.

Moral Nerve and the Error of Literary Verdicts. By Furneaux Jordan, F.R.C.S. Pp. xxiii + 141. (London: Kegan Paul, Trench, Trübner and Co., Ltd., 1901.) Price 3*s.* 6*d.* net.

THE aim of this little book is to throw some light on the effects in life and literature of two different points of view, the literary and the scientific. The first chapter lays down some "guiding truths" on mind and matter; mind is regarded as the function or action of nerve matter, just as contractility is the action of living muscle. All the manifestations of life—morals, religion, laws—are based on quantities, states and changes of nerve-matter. "Matter" is used as meaning natural stuff of which we have some knowledge. The second chapter expounds some "guiding truths" on moral nerve. Morality need not be defined; we know what it is. In men and animals the moral sense is predominant; in both, the impulse to do right is stronger than the capacity to think clearly; few men can measure the planets, but every man strives to preserve from danger the lives of his fellows. How came men and animals to be first of all moral? Because they possess moral nerve-matter; morality is nothing more than the action of moral grey-matter, and the moral apparatus came into existence because it is a factor essential to life. A material moral apparatus exists somewhere and somehow within the skull, and there are grounds for believing that moral nerve is more or less separate nerve, freely communicating with all other varieties of nerve, but characterised by greater simplicity and directness. The next two chapters are devoted to Mr. Spencer and Huxley as moralists. Mr. Spencer underestimates the potency of nerve-organisation, and is wrong in putting the origin of the moral sense quite late in the course of evolutional time, the truth being that a certain bed-rock code is found wherever life is found. In common with literary thinkers, he fails to see that creeds, philosophies and moral codes are not the producers, but the products of living human nerve. Huxley is judged by his Romanes address on "Evolution and Ethics," and the verdict is that the address is marked by not a little confusion, inconsistency and inaccuracy. The fifth chapter, on the principle of punishment, which concludes the first part of the book, introduces us to a fresh theory of the origin of morality; it now appears that the punishment of immorality is the one method by which morality originated. The chapter concludes with some interesting remarks on destructive anarchism and its remedies, but is marred by the grotesque suggestion that in order to effect a maximum of humiliation the assassin should, by way of punishment, be flogged by a woman!

Part ii., which occupies about half the book, deals mainly with the errors of literary verdicts, and if Mr. Spencer and Huxley fall short of the scientific ideal, we are not surprised that the student of nerve should find much to criticise in Tennyson, Mill, Carlyle, Emerson and Goldwin Smith. It is unnecessary to give an account of this part of the work; the author's point of view will be understood from our summary, given mainly in his own words, of part i. He has evidently read much, writes brightly, and has a fine enthusiasm for truth, but a fundamental error runs through the whole of his book; he assumes the existence of moral nerve, timid nerve, reasoning nerve, &c., and writes about them and reasons from them as if they were well-established realities like motor or sensory nerve, whereas, as a matter of fact, nothing is known about them. We should welcome any real contribution to our knowledge of the relations between the psychical and the physical aspects of thought, but the author gives us nothing of the kind, and in his crude doctrine of moral nerve, moral grey-matter and so forth he is merely playing with words.

Domestic Economy for Scholarship and Certificate Students. By Ethel R. Lush. Pp. vi + 251. (London: Macmillan and Co., Ltd., 1901.) Price 2*s.* 6*d.*

THE aim of the author of this small volume has been to provide for teachers a concise and clearly-written statement of domestic economy which shall cover the syllabus of the King's scholarship examination and the certificate examination of the Board of Education.

Domestic economy is a subject of wide range, comprising, not only the skilful management of domestic affairs and the wise expenditure of the income, but, in addition, the laws of health and the physiological principles underlying them, the management of the sick, and the intelligent treatment of ailments and accidents on general principles. The author is certainly to be congratulated on having attained her object in a most satisfactory manner. The matter is very clearly expressed, and great judgment and care have been exercised in the presentation of a difficult and complicated subject in order to maintain a suitable proportion in the treatment of the various branch-subjects comprised within the somewhat extensive scope of study of domestic hygiene.

The subject-matter is remarkably well dealt with in the short space at the author's disposal, and having regard to its variety, the teaching is exceptionally sound and correct. In a subsequent edition, however, the following facts should be taken into account:—

The illustrations of the starch grains on p. 7 are so poor as to be practically useless; the specific gravity of average cow's milk is not 1028 (p. 29); the determination of the melting point is of little value as a means of testing for margarine in butter samples (p. 37); and the most characteristic symptoms of enteric fever, consumption and small-pox are omitted, while those of other communicable diseases are given.

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.*]

Huxley's Review of the "Vestiges of Creation."

IN the "Life and Letters" of Charles Darwin (vol. ii. p. 189), Mr. Huxley wrote:—"The only review I ever had qualms of conscience about, on the ground of needless savagery, is one I wrote on the *Vestiges*."

Can any of your readers inform me where Huxley's review of the "Vestiges of Creation" was published? I imagine it to have been written about 1853–54. FRANCIS DARWIN.

Botanical Laboratory, Cambridge, February 13.

Birds attacking Butterflies and Moths.

PROF. POULTON has asked me to recall any observations of my own of the attacks of birds upon butterflies. Unless one makes a note at the time of occurrence it is seldom one can recall to mind any particular instance of the kind, although it is not so rare as it appears; but of the two following instances I have still a vivid recollection. The first occurred during the beginning of August 1892, near Wokingham, Berks.: I was chasing a Clouded Yellow (*Colias edusa*, Fabr.), the first seen of the autumn brood, so that I was all the more eager to capture it, when much to my chagrin a Spotted Flycatcher (*Muscicapa grisola*) darted from a fence and caught it. The other observation was made during the summer of 1897 and deals with one of our common moths, which I am aware are more frequently attacked than butterflies. Whilst proceeding along the Cowley Road, Oxford, I saw a House Sparrow (*Passer domesticus*), making frantic efforts to capture a noctuid moth which seemed to be a Turnip Moth (*Agrotis segetum*, Schiff.). The peculiar way in which the moth seemed to roll over and over in the dusty road and the eagerness of the sparrow, together with the loud chirping which it kept up all the time, caused quite a small knot of spectators to assemble to watch the apparently unequal contest, and when at last the moth baffled its pursuer and flew away there was an audible murmur of applause.

22 Southfield Road, Oxford. A. H. HAMM.

HAVING seen some correspondence in the last two numbers of NATURE on birds attacking butterflies, I think the following may be of interest.

Early in June, 1900, when fishing at Belleek, co. Fermanagh, I noted on several evenings very heavy "hatches" of one of the larger sedge flies (*Phryganea sp.*), locally known as the wall-fly. On these evenings large numbers of gulls would come in from the coast, four miles distant, and steadily hawk up and down the river and neighbouring meadows, taking the fly eagerly. Subsequently, when the May fly was "up" on Lough Erne, it was common throughout the day to see flocks of gulls similarly employed, and this habit was so well known to many of the local gillies that it was no uncommon thing to fish first that part of the loch where the birds were busiest. A friend of mine—a good field naturalist—informs me that he has frequently seen sparrows, and on one occasion a greenfinch, catching butterflies which, so far as he remembers, were cabbage whites.

C. G. SELIGMANN.

St. Thomas's Hospital, February 14.

AS this subject is again interesting your readers, I would repeat that both my gardener and myself have independently observed robins capture and swallow the large cabbage white butterfly. HOWARD FOX.

Rosehill, Falmouth, February 18.

King Og's Bed.

I SEE that Mr. Wells, in his interesting discourse on "The Discovery of the Future," mentions "a sort of bed of King Og, to which all expressions must be lopped or stretched." We are told in Numbers that King Og had an iron bedstead, which was 9 cubits long and 4 cubits broad. But I cannot find that he put his bedstead to the use suggested by Mr. Wells. Is it possible that this gentlemen's memory is at fault, and that he is confusing King Og with the ancient Greek robber Procrustes, who was accustomed to torture his captives by stretching them if they were too short for his bed, and by lopping off portions of their legs if they were too long to fit the bed? T. B. S.

Edinburgh, February 10.

"T. B. S." is quite right. I regret very much that I did not verify my quotation. A confusion of Og's bed and the lopping propensities of Adoni-Bezek seems to have decayed to the likeness of Procrustes. I have lived in this error for years. I have often used the image of King Og's bed in conversation and, I think, in published matter. No one has ever detected my slip, and it is by no means impossible that I am the centre of propagation of a mistake that will turn up again. H. G. WELLS.

The Severn Bore.

DURING the past three years I have been observing the bore on the Severn, and have taken several measurements of the leading wave, or "head" as it is called here, as well as of the speed of the stream.

The river at Newnham being considerably wider than it is at Stonebench, where Dr. Vaughan Cornish made his observations, or at the Denny, where Mr. Whitmell was stationed, the phenomenon is not so remarkable—the speed is less and the height is lower.

Unluckily, since February 12, 1899, the heads for some reason or another have been comparatively low; none have since that date attained to 4 ft. 2 in., the height then measured. I was fortunate to obtain a photograph, which was published in the *Graphic* of February 18, 1899, but owing to the lack of light, for the best bores come up early in the morning, the plate was underexposed.

The popular idea of the height is greatly exaggerated; 6 ft. is stated to be not uncommon when a south-west wind is blowing, but during last September the maximum measured by me was 2·1 ft. and the speed 5·2 miles per hour (330 yards in 2 mins. 10 secs.).

Mr. Whitmell refers to the sound of the approaching bore being audible for some distance. It is a weird and grand sight during the moonlit September evenings to see the white line of foam advancing up the long stretch of river above Newnham, and the sound of the approaching mass of water is heard for more than a mile away, long before anything is to be seen.

Whatever may be the safety of a small boat on the upper reaches, it is not considered safe to be in a boat when the tide comes up here, and not many years ago two fishermen were upset with their boat and drowned below Awre.

The increase of speed above Newnham is always attributed to the narrowing of the stream and to the greater steepness of the banks, but neither here nor at the Denny have I ever seen anything approaching to seventeen miles per hour.

There is another phenomenon to be seen at Newnham which does not occur higher up, namely the formation of "racers," or series of waves caused by the flowing of the rapid current over the sandbanks. These "racers" occur in rhythmical order as the channel fills up, and at some few minutes after the head has passed, lasting only for a short time at any one spot, ceasing as soon as the water has reached a certain depth; they are violent in their action, and leave a record behind them in the shape of an alteration in the configuration of the sandbank over which they have surged and boiled whilst the water in midchannel rapidly but smoothly rises in level. E. W. PREVOST.

Newnham, February 15.

Squilla desmaresti.

SHORTLY after the publication of my note in the *Journal* of the Marine Biological Association, on the appearance of this stomatopod in the North Sea, I received a specimen from Mr. W. W. Dunlop, who informed me that it had been taken off Selsea Bill. Further inquiry resulted in my learning that it was taken "about the second week in April last year." Some three or four other specimens have lately been taken in the neighbourhood, where it was till now unknown.

It would be well to call attention to this fact soon, so that fishermen may try to find out if last year's appearance was extraordinary, or the result of better or luckier observation.

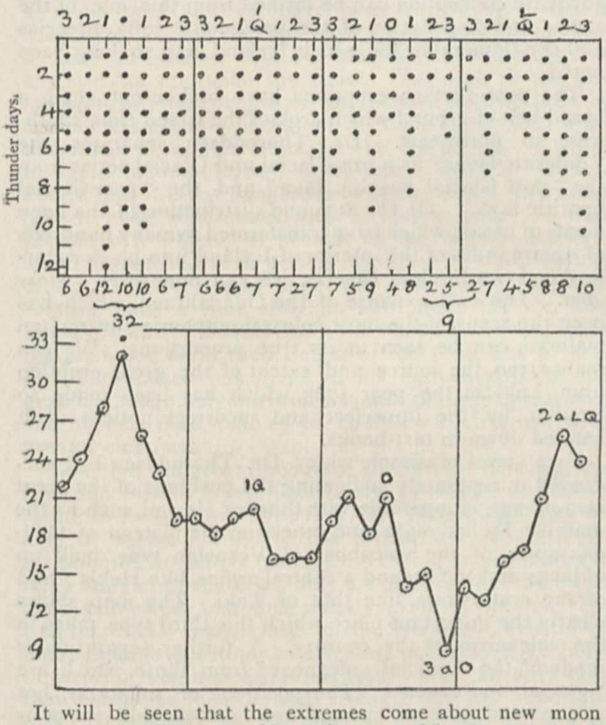
I may point out that an element in the case is the temperature of the water. F. JEFFREY BELL.

British Museum (Natural History)

The Moon and Thunderstorms.

It is known that several meteorologists have affirmed a connection between thunderstorms and the lunar phases. In his recent admirable "Lehrbuch," Dr. Hann appears to favour this idea somewhat, and he gives some account of researches on the subject (p. 662).

I do not remember to have seen the Greenwich data treated from this point of view. It might, therefore, interest your readers to see how days on which thunder was heard at Greenwich in the last thirteen years (summer half) are distributed in the week about new moon, about first quarter, &c. This is shown in the diagram, where each dot represents one such day. The number of dots in each case is given below; and in the curve, each point represents the sum of three consecutive members of this series.



It will be seen that the extremes come about new moon (maximum) and about midway between full moon and last quarter (minimum). While the three-day group commencing with second after full moon had 9, that about new moon had 32—nearly four times as many.

This curve might be usefully compared with that, similarly obtained, for wet days (or days with 0·5 in. or more) at Greenwich, in twenty-four years (given in NATURE of August 29, 1901).

Arranging those 182 days by weeks and reckoning percentages, we have:—

	Week about New Moon.	1st Qr.	Full Moon.	4th Qr.
	57	41	40	44
Per cent. ...	31	23	22	24

The latter figures may be compared with those given in Hann's work for

	N. M.	1st Qr.	F. M.	4th Qr.
Kremsmünster (Wagner)	26·4	27·4	20·9	25·3
Aix la Chapelle (Polis) ...	26·9	27·5	21·5	24·1
Batavia (van d. Stok) ...	27·4	24·5	24 2	23·9

All agree in showing a larger percentage about new moon than about full moon, and in the two earlier phases than in the two later. The values for Kremsmünster and Aix are for much longer periods, and it is possible that a larger induction for Greenwich might bring out still closer agreement. The grouping by weeks, in the case of Greenwich, seems hardly to do justice to the contrast presented. It may be well, further, to remember that a 26-day period in thunderstorms, corresponding to the sun's rotation, has been affirmed.

Sidmouth, February 6. ALEX. B. MACDOWALL.

Progressive Variation in the Malayan Peacock-Pheasant.

In looking over the specimens of this species (*Polyplectrum bicalcaratum*) in the Indian Museum, I have come across a most interesting skin of an adult male, showing variation in the direction of greater ornamentation. Normally, this peacock-pheasant has ocelli only on the wings and tail and the upper part of the back; but in the present specimen several of the black-speckled buff feathers of the back, immediately below the ocellated region, have clusters of the small spots richly glossed with green like the ocelli, the rest of the black speckling of the feather remaining normal. The green specks are always near the end of the feather, in the position occupied by the ocelli. Furthermore, this bird has the long under-tail-coverts decorated near the tip of the outer webs with a not very bright green-glossed ocellus, the inner webs merely showing black patches, such as are normal on both webs of these feathers in other specimens. Thus this individual presents on the upper surface a variation which might be advantageous in sexual selection, and beneath a similar enhancement of beauty which could hardly be of any use, since the Polyplectrons show off in an attitude which prevents any display of the under-tail-coverts. It is therefore interesting as showing how the beauty of a species might be enhanced both with and without the assistance of preferential mating on the part of the females.

F. FINN.

Indian Museum, Calcutta, January 30.

The Inheritance of Mental Characters.

FURTHER discussion of this subject (*cf.* p. 245) should perhaps be postponed until the appearance of Prof. Pearson's detailed paper. Possibly, however, it may be permissible to discuss briefly Prof. Pearson's reply to my criticism.

(1) As to the possibility of proving the "soul" factor to be a reality, I would say that it may be possible some day to estimate very exactly the value of the other two factors (heredity and environment), and it will be significant if there is then found to be a residuum not accounted for. This line of reasoning is not new; compare A. R. Wallace, "Darwinism," chap. xv.

(2) It seems to me very likely that the correlation between the mental characters of brothers would be less than between the physical, if only the factor of heredity were considered. It does not follow from this that the mental characters are less inherited, taking the race as a whole, but only that they are less evenly inherited, so that the true measure of inheritance could only be determined by studying a number of successive generations. I tried to set this forth in the paragraph which Prof. Pearson says he cannot understand.

(3) There are, however, other disturbing influences. Even at birth, we must believe that we have not the simple product of heredity, as has been well explained lately by Prof. Ewart (*Sci. Trans.* Roy. Dublin Soc., October 1901, p. 366). Again, the several faculties do not mature at the same age, so that statistics based on children "in public schools, high schools, secondary and primary schools of all classes" cannot be strictly comparable, nor does it seem possible, in the case of mental traits, to make definite allowance for age, as can be done with more or less accuracy in the case of physical characters.

T. D. A. COCKERELL.

East Las Vegas, New Mexico, U.S.A., February 1.

ICELAND.[1]

FEW parts of the earth's surface possess so strange a fascination, at once attractive and repellent, as that large island which, away to the north-west of Europe, stands between the Atlantic and the Arctic Ocean. Its language and literature, its connection with the northern mythology, the antiquity and continuity of its annals, and its quaint customs and traditions have given it a special place in the history of nations. The strange aspect of its surface and climate—the home of frost and fire, the scene of some of the most colossal volcanic eruptions which man has ever witnessed, the site of vast snow-fields and glaciers, a region shaken with earthquakes, devastated by

[1] "Geological Map of Iceland." By Th. Thoroddsen. Surveyed in the years 1881–1898. Edited by the Carlsberg Fund. (Copenhagen, 1901.)

appalling floods, swept by Atlantic storms and sometimes chilled by Greenland icebergs—these and other impressive features have made Iceland a region of peculiar interest to students of nature. To the geologist, in particular, the country offers a wide field for observation. Its ice-fields remain as relics of the Ice Age, and are still large enough to illustrate many of the characteristics of that period in geological history. Its volcanoes display almost every type of volcanic action, and present a marvellously extended chronicle, stretching back from the present day through the Glacial period into older Tertiary time. The vicissitudes of its climate and the general absence of a protecting cover of vegetation afford singular opportunities for the study of the progress and rate of denudation, while its many hundreds of miles of coast-line furnish inexhaustible materials for investigating the action of the sea on the shores, and the causes which lead to the advance or retreat of the land.

That Iceland has been much less visited than such an interesting region might have been expected to be has probably arisen mainly from two causes. In the first place, it lies a good way off, across a stormy ocean on which the means of communication are neither so frequent nor so luxurious as modern requirements demand, and, in the next place, when the traveller reaches the island, he finds that to journey through it involves, not only a good deal of expense, but exposes him to privations which he is not always well able to endure. Many who have shrunk from the voyage in face of these difficulties have longed for what comes next in value after an actual personal visit to a country—a good map of it, on a sufficiently large scale and with enough of detail to allow its main characters to be intelligently grasped. Geologists will be glad to hear that this want has now been supplied. They are well aware that for some twenty years the indefatigable Icelandic geologist Dr. Th. Thoroddsen has been at work, summer after summer, mapping his native island and publishing from time to time short notices of his investigations. Only a few of these notices have appeared in English journals; more have been translated into German, but the fullest and best accounts of his work are those in Danish, and more especially the series of papers in the *Geografisk Tidskrift* published at Copenhagen from 1884 up to the present time. Maps of various portions of Iceland, which have accompanied some of these papers, have shown with what skill and energy their author was carrying on his self-imposed task, in the midst of all the known difficulties of Icelandic travel. The work on which he has been engaged was rather the duty of a Government than what can be expected to be undertaken by a private individual. But he has stuck to it with courage until his materials have grown ample enough to permit him to embody them in a general map of the whole of the island.

This map is now issued in two sheets, printed in colours and published at Copenhagen, with the help of the Carlsberg Fund. It is on the scale of 1–600,000, or about ten English miles to an inch, which is large enough to show much detail that has never yet been expressed on a single map and summarised in so clear and intelligible a manner. The title and explanations of signs and colours are given in English. The map presents a more striking picture of the geology and physical geography of the island than has ever been before available, and contains a vast fund of instructive information in regard to matters not only of local, but of theoretic interest.

One of the first features to catch the observer's eye, as he glances at the distribution of the colours, is the wide area occupied by the Tertiary basaltic plateau. This vast underlying platform, on which all the later volcanic manifestations have been displayed, still forms the surface of most of the western, northern and eastern districts. Its nearly horizontal sheets of dark brown rock have been cut into innumerable fjords and inlets on the coast, above which they rise in long lines of mural precipice. Among the basalts lie layers of terrestrial vegetation, the famous lignites or "Surtarbrandur," the positions of which, where known, are indicated on the map. The plateau is diversified by the uprise of numerous masses of liparite and granophyre, which are especially developed in the eastern part of the island. They may be compared with the granophyre intrusions which have disrupted our own Tertiary volcanic plateau in the west of Scotland. A further coincidence between the volcanic geology of the two regions is to be seen in the scattered patches of gabbro shown on the map, though this rock does not appear to play the important part in Iceland which it does among our Western Isles. For the first time some adequate conception can be formed from this map of the extent and distribution of the palagonitic tuffs, breccias and conglomerates, for which Iceland has so long been noted.

The post-Tertiary eruptions have broken out along a broad belt of ground which crosses the island from south-west to north-east. Dr. Thoroddsen separates the "doleritic lavas" as a pre-Glacial and Glacial series from the "post-Glacial basaltic lava" and the "post-Glacial liparitic lava." Of the area and distribution of the huge floods of basalt, which have transformed so many hundreds of square miles of the interior of Iceland into black waterless and verdureless deserts, we can now form a clear idea. The vast expanse of the Odádahraun, which has been the scene of the most colossal outpouring of molten material, can be seen in its true proportions. We can realise, too, the source and extent of the great eruption from Laki in the year 1783, which has been made so familiar by the imperfect and incorrect notices of it handed down in text-books.

By a series of simple signs Dr. Thoroddsen has succeeded in separately indicating the positions of the great lava-domes, comparable with those of Hawaii, such as the massive Trölladyngja and others on the plateau of Odádahraun; of the volcanoes of Vesuvian type, built up of lavas and tuffs round a central orifice, like Hekla; and of the crater-rows, like that of Laki. The map shows clearly the important place which this third type takes in the vulcanism of the country. A further separation is made of the "glacial volcanoes" from those which are "glacial and recent." The positions of solfataras, hot springs and mineral springs are marked, and space is found for lines showing the trend of raised beaches and the highest ascertained limit of submergence.

Nor are the superficial formations omitted; the various Drift deposits of the uplands are represented by one tint and those of the lowlands and valleys by another, while on the south coast, the wide stretches of sand and mud, discharged by the hundreds of streams that descend from the great snow-fields and glaciers of the Vatnajökull and the western Skaptafells district, are distinguished from the other recent accumulations. An interesting feature of the map will be found in the arrows that mark the direction of the ice-striæ on the rocks. These signs indicate that while the general movement of the ice-sheet has been outwards on all sides, each separate mass of high ground has exercised an influence in guiding the ice-drainage. This local effect is well brought out in the north-western peninsula, where the striæ descend into the fjords on either side of the main watershed. The Glámu Jökull, which still caps that portion of the basaltic plateau, is thus the lineal descendant of the ice-fields that once spread over the whole island.

In comparing the coast-line of different parts of the island as depicted on this map, the geologist cannot fail to be struck with the contrast between that of the southern district and that of the rest. From Reykjavik right round the western, northern and eastern sides of Iceland, where the ancient Tertiary basalt-plateau meets the sea, the shores are deeply indented with innumerable fjords and little inlets, above which the rocks rise in long lines of terraced cliff. Along the southern coast, the margin of the land consists for the most part of low flats and bars of fine sand and mud, brought down by the many rivers and streamlets that escape from the edges of the great glaciers and snow-fields. A contest is constantly waged between the Atlantic breakers, on the one hand, and the sediment-bearing inland waters, on the other. Bars and spits are thus thrown up, behind which stretch long narrow lagoons. For a distance of some 250 English miles such is the general character of the coast-line. In spite of the fury of the Atlantic storms and the occasional breaking down of the detrital barriers opposed to them, the sea has been losing ground. Since the Ice Age so much sand and silt have been carried down that a wide stretch of lowland has been gained, and the sea has become so shallow that for long distances no ship of any size can approach the coast. Yet such is the unfortunate physical geography of Iceland that, at least in the meantime, this accession of land brings but little advantage to the inhabitants. The territory is so liable to rapid inundation, and to be swept over by sudden floods, that it is too dangerous to be reclaimed, and often cannot even be crossed without serious risk. In that portion of it which lies nearest to the Mýrdal glaciers, an additional source of peril is furnished by the eruptions of Katla, which, buried under the snow-fields, from time to time finds a vent, disrupts and melts the ice, and sends it in huge masses down the floods that sweep over the plain and carry their freight of ice even out to sea. Dr. Thoroddsen has given in his various publications graphic though only too brief accounts of these operations, and his new map enables us to follow their scope with greater clearness.

Now that the great labour of preparing this map has been successfully accomplished, every geologist and every visitor to Iceland will hope that Dr. Thoroddsen may be able to devote himself to the preparation of a full description of his native country. He has accumulated a large amount of material, only a small part of which has been published, and this merely in brief outline. He has, doubtless, many parts of the island to revisit and many difficult questions to elucidate before such a volume or series of volumes can be written. We can only wish him continued health and strength for his important task. It is surely not too much to hope that work of so national a character and of so much general scientific interest will meet with such hearty support and aid in Denmark that it may be vigorously prosecuted to an early and successful conclusion. ARCH. GEIKIE.

NATURE STUDY IN SCHOOLS.[1]

WE have received the first part of the *Nature-Study Journal*, published by the South-Eastern Agricultural College, Wye, Kent, with a preface by Sir William Hart-Dyke and an introduction by the editor, Mr. A. D. Hall, principal of the College. This new publication is the outcome of a discussion held at the College during a summer course for teachers in 1901, and the thirty-one teachers, mostly from schools in Kent and Surrey, whose names are appended to the part received constitute the first members of a Nature-Study Society by which this journal will be maintained. The object of the journal, as set forth in the preface and introduction, is mainly to facilitate the teaching of "nature-knowledge" in rural schools, by enabling the teachers to interchange ideas and schemes of instruction and to be in communication with the Wye College as a central organisation. The whole subject of nature-teaching in rural schools has been brought into prominence of late years, and there has been a distinct revival in this branch of education to which we have, from time to time, called attention in these columns. The initiatory work of the Countess of Warwick in emphasising by practical example the necessity for the establishment of schools of science in rural districts (see article by Lady Warwick and Prof. Meldola, NATURE, vol. lix. p. 7), followed by the work of the Agricultural Education Committee inspired by Sir William Hart-Dyke and Mr. Henry Hobhouse, has been largely instrumental in bringing about this much-needed reform, and the demand for sound instruction in this kind of science has naturally been on the increase since the issue of the "Specimen Courses of Object Lessons, &c." by the Board of Education (NATURE, vol. lxiii. p. 603). It is to be hoped and expected that this demand will go on increasing, and the establishment of the present journal is therefore opportune. The great danger to education in this country is complete apathy and neglect in the first place, and then reckless precipitation and unorganised excess in order to try to recover lost ground. Rural education is bound to go through the usual phases, and we may already begin to ask ourselves whether there is anything to be gained by the multiplication of organisations, conferences and congresses, all carrying on much the same work and frequently overlapping in functions.

The Nature-Study Society has, however, in favour of its creation the circumstance that it is composed of teachers who are engaged in giving actual instruction in this subject in schools, and the journal is to be largely devoted to the publication of specimen lessons. Two such lessons are in the part before us, one on "Leaves and their Veining" by Mr. H. Brooker, of the Ewhurst National School, and the other by Mr. A. E. Chandler, of Puttenham, on "Dodges of Nature." The first point that cannot fail to strike the reader of these two lessons is their extraordinary divergence in standard. The collecting and classification of leaves according to their veining is a lesson in pure observation. The "dodges" referred to in Mr. Chandler's lesson are the contrivances for cross-fertilisation in long and short-styled primroses and in Salvia, and the pupil is afterwards told to collect some flowers of Arum, to study the inflorescence, and then to work out for himself the mechanism of fertilisation by the aid of hints given in the following form:—"What can be the work of the little hairs that nearly close the opening of some of the hoods? Do you notice any insects? Did you ever think out the design of an eel-trap or a lobster-pot?" It is obvious that these two lessons must appeal to pupils of different ages and acquirements. The new Society and its journal should have a useful career if only by enabling teachers to compare schemes, as in the two lessons noticed. Such specimens bring out very clearly the necessity for graded and connected series of lessons leading from simple observation and description up to observation combined with inductive reasoning. The introduction of nature study into rural schools cannot but be productive of good, and although, as the editor points out, it is not primarily directed to keeping children on the land, it may have this effect indirectly by leading children "to see that a country life has its own interests and is not merely stupid routine; particularly we want the children who do stay in the country to have laid a foundation of thinking about rural pursuits which can be built upon later." The Society will welcome as new members all teachers who are conducting nature-study classes, the only obligation being that the member shall be expected to send a specimen lesson for publication. The Society is worthy of support, and we commend it to the notice of teachers who are already holding, or who desire to conduct, classes in this subject, which is one that by proper handling can be made really fascinating to children of every degree of intelligence.

[1] *The Nature-Study Journal.* Published by the South-Eastern Agricultural College, Wye. No. 1. Pp. 12. (*Kentish Express* Office, Ashford, Kent.) Price 3*d.*

A DOUBTFUL DEVELOPMENT OF LOCOMOTIVE ENGINEERING.

UNDER the heading of "A New Development of Economical Railway Haulage," the *Times* of February 13 tells us that "we are on the eve of a mechanical revolution such as has never been seen since the introduction of steam," and enters in a general way into a statement of results said to have been obtained from an old Great Northern locomotive fitted with a new type of valve-gear, the use of which is said to reduce the consumption of coal nearly 50 per cent. and increase the hauling capacity of the engine considerably, when compared with a sister engine fitted with the ordinary gear and doing similar work.

Locomotive engineers are becoming accustomed to the rapid advances of electrical science, and seldom doubt what the electrical engineer may claim to have achieved; but with the locomotive things are different; the machine is not new, neither is the valve-gear; the coal consumption has been thoroughly tested and the various gears examined from every point of view, there being no particular variation of opinion as to the most beneficial distribution of steam in the cylinders.

For this reason it is extremely startling to be told that a modified valve-gear will reduce the fuel bill nearly 50 per cent. with an increased load, the boiler pressure being only 140 lbs. per square inch, considerably below the average working pressure of to-day.

The locomotive experimented upon was built in 1882, and was, therefore, of the late Mr. P. Stirling's design, a type of locomotive famous for having a very small boiler in proportion to the cylinder dimensions, and, therefore, one requiring to be forced to keep up the steam, the forcing being done by a very keen draught induced by a small blast-pipe; such engines are famous for throwing fire from the chimney-tops. Yet, besides claiming this abnormal economy, we are told that the exhaust is so soft that the question of fire-throwing is entirely got over and that spark arrestors may be considered things of the past—surely a wonderful result.

The article referred to fills a whole column of the *Times*, but we may be allowed to doubt the results given, for although the name of Mr. H. A. Ivatt, the locomotive engineer of the Great Northern Railway, is quoted more than once, the statements do not appear over his name, and until they do, locomotive engineers may be excused if they continue to hold adverse opinions. The economical working of the locomotive is no new study; it is in the hands of able men who, no doubt, would be highly delighted if they could clearly demonstrate a saving of 5 per cent. even over previous practice. N. J. L.

NOTES.

SIR WILLIAM ROBERTS-AUSTEN, K.C.B., F.R.S., will deliver the tenth "James Forrest" lecture, on "Metallurgy in Relation to Engineering," at the Institution of Civil Engineers on Wednesday, April 23, the date having been unavoidably altered from that originally proposed.

ARRANGEMENTS have now been made for Major Ronald Ross, Walter Myers lecturer in the Liverpool School of Tropical Medicine, to proceed for the third time to Freetown, Sierra Leone, on the work of the School. The expedition which he will rejoin is the fifth organised by the School, and went out early last year under Major Ross himself with Dr. Logan Taylor.

THE International Congress on the Methods of Testing Materials, held in 1900, decided to offer a prize of 3500 francs to the author who has made the most important contributions to the subjects for the advance of which the Congress was organised. The adjudication of the award of this prize has just been placed in the hands of the Comité des Arts mécaniques of the Paris Société d'Encouragement.

ARCHÆOLOGISTS and other students of antiquities will be glad to learn that it is proposed to obtain for Magdalene College, Cambridge, a copy of the head of Mr. F. C. Penrose, F.R.S., honorary fellow of the College, from the portrait painted by Mr. Sargent, R.A., for the Royal Institute of British Architects. The portrait will be presented to the College in recognition of Mr. Penrose's valuable services both to science and art. Among the supporters of the proposal are Dr. J. W. L. Glaisher, F.R.S., Sir R. C. Jebb, Prof. Liveing, F.R.S., Sir J. Norman Lockyer, K.C.B., F.R.S., Mr. A. G. Peskett and Lord Thring, K.C.B. Subscriptions are invited and should be sent (crossed Barclay and Co., Cambridge) to Prof. A. Newton, F.R.S., Magdalene College, Cambridge.

THE president of the Royal Geographical Society has made a special appeal to the fellows of the Society on behalf of the relief ship which must start not later than July next to obtain news of the *Discovery* and render assistance if necessary. It appears from the circular issued by the president that only 150 of the 4000 fellows of the Society have yet contributed to the funds for the relief ship. The council has, however, made itself responsible for the ship, which is now lying in the Thames and will shortly require to be furnished with stores and equipped with officers and crew. A spirit of loyalty should induce fellows of the Royal Geographical Society to provide the funds which will relieve the council of anxiety and ensure that essential precautions are taken for the safety of the members of the National Antarctic Expedition.

THE annual meeting of the Society for the Protection of Birds will be held on Wednesday, February 26, at the Westminster Palace Hotel, Victoria Street, London, S.W. The chair will be taken at 3 p.m. by Sir George W. Kekewich, K.C.B., secretary to the Board of Education. A proposal to establish a Bird and Arbor Day throughout the British Isles will be considered.

ON Tuesday next, February 25, Mr. W. N. Shaw, F.R.S., will begin a course of two lectures at the Royal Institution on "The Temperature of the Atmosphere, its Changes and their Causes." The Friday evening discourse on February 28 will be delivered by Prof. H. A. Miers, F.R.S., his subject being "Gold Mining in Klondyke," and on March 7 Prof. H. Becquerel, Membre de l'Institut, Paris, will deliver a discourse (in French) on "Radioactive Bodies."

A DISASTROUS earthquake occurred in Transcaucasia on February 13. Shemakha, the principal town in the area affected, has been completely laid in ruins, more than 20,000 people having been rendered homeless and 2000 lives lost. The first shock was felt about midday on February 13, and in a few seconds the Orthodox church, the mosques, the public buildings and hundreds of houses had fallen. The shocks were felt over a very wide area, and continued to recur during several days. A writer in the *Evening Standard* points out that in such a region as that affected the shocks may continue for a long time. To the north rises the great chain of the Caucasus, a region of crystalline and sedimentary rocks bent into great folds, not less remarkable than those in the Alps. In such a locality earth-tremors are at any time possible. In the latter chain no trace can be found of an extinct volcano, but Elbruz, the highest summit in the Caucasus, and Kasbek, which easily overtops Mont Blanc, are both ruined volcanic cones. Many more, though on a much smaller scale, are scattered over the region south of the Caucasus. In fact, signs of volcanic action are abundant over a very large part of the great upland plateau south of the Caucasus—the region where Turkey, Russia and Persia meet.

Ararat itself, though its crater has vanished, is an extinct volcano, for its rocks, where they disappear beneath the summit snows, are merely scoria. Some others, however, still retain their craters in a more or less perfect condition. A renewal of earthquakes and of volcanic eruptions, therefore, is not surprising. All the south of the Caucasus has occasionally suffered in this way. The neighbourhood of Ararat was severely visited in 1840; there was a bad earthquake in Asia Minor fifteen years later, and shocks are not infrequent in various parts of the region between the Black and Caspian Seas, the Eastern Mediterranean and the valley of the Euphrates.

PROF. E. C. PICKERING has completed twenty-five years of service as director of the Harvard College Observatory; and we learn from *Science* that in recognition of this fact the staff of the Observatory has presented him with a silver cup.

MR. HARRY F. WITHERBY is about to leave England on a new ornithological expedition to Persia. It is Mr. Witherby's intention to penetrate the mountainous region north-west of Shiraz, after working the area between that town and Bushire.

THE seventieth annual meeting of the British Medical Association will be held at Manchester on July 29, 31 and August 1. The president is Dr. G. B. Ferguson and the president-elect Mr. W. Whitehead. An address in medicine will be delivered by Sir Thomas Barlow, Bart., K.C.V.O., and an address in obstetrics by Prof. W. J. Sinclair. The scientific business of the meeting will be conducted in seventeen sections, which, with their presidents, are as follows:—Medicine, Dr. J. Dreschfeld; surgery, Mr. J. Hardie; obstetrics and gynæcology, Dr. D. L. Roberts; public medicine, Dr. J. Niven; psychological medicine, Mr. G. W. Mould; physiology and anatomy, Prof. Wm. Stirling; pathology, Prof. Sheridan Delépine; ophthalmology, Dr. David Little; diseases of children, Dr. H. Ashby; laryngology, Dr. A. Hodgkinson; otology, Dr. W. Milligan; navy, army and ambulance, Brigade-Surgeon-Lieutenant-Colonel G. S. Elliston; dermatology, Dr. H. A. G. Brooke; pharmacology, Dr. N. I. C. Tirard; ethics, Dr. S. Woodcock; industrial hygiene and diseases of occupation, Dr. A. Whitelegge; tropical diseases, Sir W. R. Kynsey, C.M.G.

A SPECIAL committee of the Franklin Institute, Philadelphia, has reported in favour of the adoption of the metric system of weights and measures in the United States. The National Government is urged to enact such laws as will ensure the adoption of the system in its various departments, as rapidly as may be consistent with the public service. A number of questions have been discussed by the committee, and definite answers agreed upon. Thus, the opinion is expressed that no valid objection has been effectively urged against the metric system except that the numerator cannot be divided by two. A similar objection could, of course, be applied to the decimal system of currency in use in the United States. For convenient small units of everyday measurement, the millimetre is held to be better than either 1/16 inch or 1/32 inch, the latter being rather a fine subdivision for ordinary rough measurements. If the National Government can be induced to adopt the system in all its departments, it is believed that the adoption of metric measures throughout the country would follow within a reasonable time.

AT the Imperial Institute on Monday, Dr. C. F. Harford-Battersby, principal of Livingstone College, gave a lecture on "The Obstacles to Development in West Africa." After referring to some of the minor impediments to West African development, a description was given of the discoveries which have recently been made with reference to the malaria question. It is now admitted by all malarial specialists that the mosquito is the means of communicating this, and some other diseases, to man. In this connection reference was made to Major Ross and also to Dr. Manson, under whose leadership the London School of Tropical Medicine has done such useful work, both in educating a large number of medical practitioners proceeding to different tropical climates and in various expeditions for investigating the subject of tropical disease. The Liverpool School of Tropical Medicine has also conducted a series of investigations into the subject of malaria on the west coast of Africa, and is now engaged in carrying through important sanitary operations besides education work in this country. Dr. Harford-Battersby referred to the instruction that is being given at Livingstone College to missionaries in questions of tropical hygiene and to the facilities afforded by the Travellers' Health Bureau, mainly by means of the quarterly journal *Climate*, to those who might desire information with regard to what precautions should be taken in entering a tropical climate. In conclusion, he hoped that the Governments of the different Colonies would take up in real earnest the sanitary measures necessary to carry into practical effect the important discoveries which have been made by scientific experts, and that the public generally would recognise the necessity of acting upon the recommendations which have been made as to protection from mosquitoes and would cooperate in carrying through adequate sanitary reforms.

WE have received the *Annales* of the Magnetic Observatory of Copenhagen for 1897-8, of which Dr. A. Paulsen is director. The observatory is to be congratulated as being one of the very few institutions that publish magnetic observations in detail. The present volume contains hourly values of declination and horizontal force, and in addition the hourly and daily means have been computed, and the absolute extreme values are stated for each day.

DURING the past week most parts of this country have experienced severe night frosts. In the neighbourhood of London the thermometer has fallen as low as 14° in the screen, and 7° on the ground. In the midlands the readings have been considerably lower, and the exposed thermometer fell below zero. The temperature during February has not been so low since 1856, with the exception of three days in February 1895. The day temperatures have been low in most parts of the kingdom. On Sunday, with a maximum shade temperature of 35°, the solar radiation thermometer rose to 80° at Greenwich.

THE Report of the Meteorological Council for the year ending March 31, 1901, has just been presented to Parliament. The Council has been reconstituted and now consists of five of the original members, who act as directors; these receive remuneration for their services. Five additional members have also been appointed by the Royal Society, among whom we are glad to see the name of Dr. R. H. Scott, who has been so intimately connected with the Office since its transference from the Board of Trade in 1867. Mr. Francis Galton, whose work was especially noteworthy in connection with the improvement of meteorological instruments and methods, and who first suggested the term "anti-cyclone," now so commonly used, has retired from the management on account of age. The superintendence of the supply of meteorological instruments for the use of the National Antarctic Expedition was undertaken by the Council, and after consultation with Sir G. G. Stokes, the Campbell-Stokes sunshine recorder was remodelled, to register during the twenty-four hours. Among the more important operations of the Council may be mentioned the arrangements for the investigation of the London fog, in cooperation with the London County Council, the establishment of observations at 7h. a.m. in connection with the German and Dutch Meteorological Offices, for the improvement of the telegraphic weather service, and the preparation of monthly pilot charts of the north Atlantic and Mediterranean, which have been frequently noticed in our columns. Arrangements have also been made, at the request of the United States Weather Bureau, for sending daily weather telegrams to Washington. The percentage of complete and partial success of the weather forecasts reached eighty-four, which is higher than that for any year during the last decade, except 1893, when the same high figure was attained. The success of storm-warning telegrams was 92 per cent.

A PAPER on wireless telegraphy is given by Prof. F. Braun, of Strassburg, in the *Physikalische Zeitschrift*, iii. No. 7. Without going into elaborate details as to the transmitter and receiver, it may be mentioned that the problem of resonance received careful attention in the construction of these apparatus, the desirable conditions being that waves of a certain frequency alone should be transmitted and received and that the receiver should be as sensitive as possible to these particular waves. The experiments were commenced by Prof. Braun at Strassburg in 1898; in 1899 they were continued at the mouth of the Elbe. Communication was set up between Cuxhaven and a lightship distant thirty-four kilometres. Later, messages were transmitted between Cuxhaven and Heligoland at a distance of sixty-five kilometres. It was thought possible that by means of an acoustical instead of a writing receiver, the distance from which messages could be received could be increased two and a half to three times.

IN connection with the campaign against hailstorms, Prof. V. Monti publishes in the *Bulletin* of the Italian Meteorological Office some statistics of the number of storms accompanied by snow at different stations, as recorded for the period 1881–1887 inclusive. The phenomenon of snow during thunderstorms is shown to be very rare in Italy, and in about one-fourth of the storms in which snow fell it was also accompanied by hail. When account is taken of the time of year as well as of the altitude of the station, it is found that in the majority of cases snowy thunderstorms occurred when snowy weather was the normal condition of affairs. There are but few records of snow falling out of season as a result of the sudden cold produced by thunderstorms. These statistics, so far as they go, are interesting as affecting the theory that by bombarding a thunderstorm the hail is transformed into snow. If snow frequently falls after a storm-cloud has been bombarded, and rarely under other circumstances, the theory in question obtains support. But, as Prof. Monti points out, we have not at present sufficiently complete statistics to enable any very definite conclusions to be drawn.

JUDGING from the capital figures which illustrate an article by "S" in *Globus* (Bd. lxxxi. p. 58) on the perforated landscapes of Kappadocia, that country must present a most remarkable appearance. In the district of the ancient Cæsarea-Mazaca, a plateau composed of a bed of tuff is topped by a layer of lava; denudation has resulted in broad cañon-like valleys, from the flat floors of which arise innumerable pointed sugarloaf shaped pinnacles. Many of these have been pierced and tunnelled for dwellings for ages past, and the caves are still being made. Some of the caves were used for religious purposes, and we have ruins of temples and of Byzantine churches carved out of the solid rock.

THE current number of *Man* contains several interesting papers. Prof. Flinders Petrie gives a plate illustrating two dozen hitherto unpublished prehistoric Egyptian figures of men and animals. The Rev. R. A. Gatty describes his finds of pigmy flints from Lincolnshire; perfectly similar flints have been found in various other localities in England, as well as in Belgium, in France, and in India. These problematical implements are of very delicate workmanship, but more information is required before any definite statements can be made as to their use or their users. Mr. Gatty believes that they were actually made at Scunthorpe in Lincolnshire from flint river pebbles.

DR. WALTER E. ROTH, the Northern Protector of Aboriginals, Queensland, has recently published his third *Bulletin* on North Queensland ethnography. The subject is "Food: its Search, Capture and Preparation," and there is no need to say more than that the facts are presented with that fulness of knowledge and concise detail that characterise all Dr. Roth's writings. As an example of this thoroughness it may be mentioned that Dr. Roth refers to some 240 plants which are used as food in some form or another, the scientific name of each plant being given. In addition to these, the natives know of twenty-two plants which they use to stupefy or poison fish. The plates illustrate the various kinds of baskets, nets, snares, &c. used by the North Queensland blacks. The only fault we have to find with this very valuable paper is its shape, but being a Government Report it is probably unavoidable that it is printed of Blue-book shape; this must be put down to the official mind and not to Dr. Roth. The *Bulletin* is marked C.A. 81—1901, Home Secretary's Department, Brisbane.

THE principal article in *Nature Notes* for February is one on the enemies of trout, by Mr. E. T. Daubeny.

IN the February number of the *Irish Naturalist*, Messrs. Mellard Reade and J. Wright describe the occurrence of marine boulder-clay in county Cork, with a list of the contained Foraminifera.

OWING to the roughness of the passage, which has to be made in an open boat, visitors to the little island of Bardsey, lying off the extremity of Caernarvon, are few and far between, and it is therefore a favourite resort for birds of many species. A list of the species met with during a visit to the island in May of last year is given by Mr. O. V. Aplin in this month's *Zoologist*.

THE history of the gradual diminution of the habitat in Britain of the swallow-tailed butterfly appears in the February number of the *Entomologist's Monthly Magazine*. At the present day this fine species is met with only in Wicken Fen and Ranworth and certain other Broads in Norfolk. Formerly, however, according to the author, Mr. C. W. Dale, it occurred in no less than fifteen other English and Welsh counties.

TO the February issue of the *Entomologist*, Mr. W. J. Lucas contributes an account of the dragon-flies taken in Britain during the past year. Very interesting is the occurrence in Hampshire of the form known as *Oxygastra curtisi*, which has not been observed in Britain since 1882, when four specimens were taken at the same place. The author hazards some suggestions as to the breeding place of this rare insect in Hampshire.

IN a recent issue of the *British Bee Journal*, Mr. F. W. L. Sladen raises the question whether bees can hear. The author claims to have discovered that the so-called Nassanoff's organ—the membrane between the fifth and sixth dorsal segments of the workers—is really a scent-producing organ, and that this scent forms a means of communication between bees. He further suggests that bees have cognisance only of the well-known "hum," and do not recognise ordinary sounds.

THE second number of *The Emu* fully bears out the promise of its predecessor, and is illustrated by some excellent reproductions of photographs of Australian birds' nests. Perhaps the most generally interesting and important article is one by Mr. D. le Souëf, on protective coloration in Australian birds and their nests, which is to be continued later. In a second, Mr. J. C. M'Lean accounts for the appearance of the swamp-hen, or bald coot, in localities in New Zealand where it was previously unknown, by the clearance and drainage of many of its former haunts.

IN the Report for 1901 on the Lancashire Sea-Fisheries Laboratory at Liverpool and the Sea-Fish Hatchery at Piel, Prof. W. A. Herdman directs attention to the urgent need on the Lancashire coast of a special steam vessel for the purpose of scientific and statistical work. The Fisheries Branch of the Irish Agricultural Department has now such a steamer working under the direction of a scientific adviser; and if similar investigations could be undertaken on the opposite side of the channel, and the two vessels worked on a common programme, Prof. Herdman is of opinion that "this most definitely circumscribed area of the British seas would be adequately investigated." It is earnestly to be hoped that the necessary funds may be obtained without difficulty. The general work of the laboratory has been carried on with success. At the Piel hatchery attention was confined during the year to the flounder, but in the current year more attention is to be devoted to the incubation of the eggs of the plaice. Appended to the Report is an account of the morphology and life-history of the plaice, by Messrs. Cole and Johnstone, forming No. 8 of the *L.M.B.C. Memoirs*. This appears to be the most elaborate account of any single species that has hitherto been published, and reflects the greatest credit upon its authors, who have devoted two years to their task. The plaice, which is one of the most important of the British food-fishes, is a local and sedentary type on which the effects of excessive fishing would be almost sure to make themselves felt, and it has been the subject of more than one Government investigation. The importance of a full knowledge of the structure and habits of this fish, such as the authors give us, cantherefore, be scarcely overestimated. Much is to be hoped from the experiments in hatching and rearing the eggs and fry of the species alluded to above, for, as Prof. Herdman well observes, hatching and rearing are the real objects of institutions like the one under his direction, "And scientific men who have charge of fish-hatcheries will not be content till they have succeeded in rearing into young fish, at a reasonable cost, a sufficiently large proportion of the fry which they can now hatch from the eggs by the million."

WE have recently noticed Mr. D. G. Elliot's "List of the Land- and Sea-Mammals of North America," published at Chicago (NATURE, January 9). Since then we have received a copy of another work on nearly the same subject, prepared by Messrs. Miller and Rehn and issued by the Boston Society of Natural History. It is entitled "Systematic Results of the Study of North American Land-Mammals to the Close of the Year 1900," and embraces a larger area than Mr. Elliot's list, as it includes in North America the whole of the continent down to the isthmus of Panama and the West India Islands. It also serves to show, even more plainly than Mr. Elliot's list, the enormous additions lately made by the active zoologists of the United States to our knowledge of the North American mammal-fauna. Whereas Mr. True in 1885 only included about 400 species in his summary of this mammal-fauna, the authors of the present work enumerate no less than 1450 species and subspecies. Whatever may be the opinion of other naturalists about the status of some of these species and subspecies, all will allow that Messrs. Miller and Rehn have furnished us with a very useful summary of the results of the study of the North American mammals during the past fifteen years.

A WORK on "Meteorologische Optik," by Prof. J. M. Pernter, is in course of publication by Herr W. Braumüller, of Vienna and Leipzig, and the first part has been received. Prof. Pernter has given so much attention to the physical side of meteorology, and the analysis of optical phenomena, that his complete work ought to be of great interest. The part of the subject already treated is too general to admit of review, and we propose to defer our notice of the work until the whole of the parts have been published.

A SECOND edition of Prof. J. M. Coulter's inspiring little text-book entitled "Plant Relations: a First Book of Botany," has been published by Messrs. Hirschfeld Brothers. The chapters dealing with plant societies have been revised both in text and illustration, but otherwise few alterations have been made. As remarked in the review of the first edition (March 8, 1900, vol. lxi. p. 442), the book is an interesting and refreshing little manual, which ought to receive the attention of the teacher as well as the pupil. It should be of real service as a guide to nature-study.

WITH the laudable object of bringing science and scientific principles into every-day life and thought, a society has been formed and has issued a journal under the title of *Life*. The organisation at present has no name and its only designation is "our Society." A useful department of the journal is that in which advice is given as to the choice of books on various branches of science. There is an article on medical training and ideals, one on science and art in literature, and a third on the inaccuracies of the Old Testament—a subject which is perhaps better left alone by a society which hopes for success. The journal is edited by the secretary, Mr. R. A. Buddicom, 17 Craven Hill Gardens, Hyde Park, London, W., to whom all communications should be addressed.

THE *Transactions* of the Epidemiological Society (new series, vol. xx. 1900-1901) show that the Society is doing much to encourage the scientific study of disease. Dr. P. Manson, in a paper on some problems of tropical epidemiology, describes the work which has been done to establish the connection between mosquitoes and malaria, and suggests directions of further development. Why is it that Samoa, to take an instance, is free from malaria, while Mauritius has the disease present? The answer is probably that there is some organism in Samoa which is fatal to the malaria-bearing mosquito—Anopheles—while in Mauritius the insect can flourish; but the reasons for such differences are not clearly understood, and a systematic inquiry must be made before the conditions inimical to Anopheles can be exactly known. Similar remarks apply to diseases other than malaria; and Dr. Manson points out that expeditions to discover the causes and remedies of such diseases are even more necessary than expeditions to determine points of geological or geographical interest. Another paper in the volume is on plague in the nineteenth century, by Dr. A. K. Chalmers, who gives particulars of the outbreak of plague in Glasgow. Rats were plentiful in the affected houses, but they appeared to have escaped infection. Nearly three hundred rats were examined, but nothing suggesting plague was found. These results were in marked contrast with those described by Dr. Tidswell, of Sydney, at the close of Dr. Chalmers' paper. The facts obtained at Sydney showed conclusively that the plague was transmitted by fleas from infected rats. Among other papers we notice one on the diagnosis of plague, by Dr. E. Klein, F.R.S., which has already appeared in NATURE (vol. lxiv. p. 91); soil and typhoid fever, by Dr. J. T. R. Davison; and principles determining the geographical distribution of disease, by Dr. L. W. Sambon. A portrait of the late Prof. Max von Pettenkofer, of Munich, forms the frontispiece of the volume, and an obituary notice of this eminent investigator appears among the contents.

THE question of the nature of red phosphorus is one that has been frequently discussed, the general trend of the evidence being to show that red phosphorus is a polymer of white phosphorus. Some new and interesting experiments on this subject are contributed by Dr. R. Schenck to the current number of the *Berichte*. Starting with the well-known equation of van 't Hoff $-dC/dt=k.C^n$, in which C is the concentration, *t* the time, and *n* the number of molecules taking part in a reaction, he determines the velocity of transformation of white into red phosphorus in solution in phosphorus tribromide at 172° C. and 184° C., and finds that $n=2$ is the only value of *n* which gives a constant value for *k* in the velocity equation. From this the conclusion is drawn that the equation $(P_4)_2=P_8$ represents the first stage of the conversion of white into red phosphorus. It is, however, quite possible that this only represents the first stage in the process, the differences in the properties of the two varieties being so great that it is unlikely that they could be caused by such a small change in molecular weight.

AN important discovery in medical science is announced by M. Armand Gautier in the current number of the *Comptes rendus*. He has found that sodium methylarsenate, injected into the blood in minute amounts, is an absolute cure for malarial fever. Particulars are given of the treatment of nine cases, all of which had been contracted in Africa, and which were of such a severe type as to be refractory to large doses of quinine. The nine cases were rapidly cured, two only showing a slight relapse, and these yielded at once to a second injection. The progress of the cure was followed in each case by the examination of the blood, and the treatment was always followed by the disappearance of the specific hematozoa. The salt was also found to suppress entirely the anæmia associated with malaria. M. Gautier regards the results as sufficiently definite to authorise the substitution of this drug for quinine in pernicious malaria, although it still remains for further researches to determine the best dose, and whether administration by the mouth or hypodermically is to be preferred.

A COMPLETE index of the first thirty volumes of the *Journal de Physique* (1872-1901), arranged both according to authors and according to subject-matter of papers, has been announced.

THE behaviour of liquid sulphur dioxide as a solvent has been very completely investigated by Messrs. Walden and Centnerszwer, an account of whose researches is contained in vol. xxxix. of the *Zeitschrift für physikalische Chemie* (pp. 513-596). It is found that liquid sulphur dioxide easily dissolves a large number of (binary) inorganic salts and most salts of organic bases. The solutions of these salts are good conductors of electricity. The simple laws which regulate the conductivity of aqueous solutions of salts are in general not valid for the sulphur dioxide solutions. Amongst these may be mentioned Kohlrausch's law of the independent wandering of the ions, Ostwald's dilution law, the law according to which the molecular conductivity approaches to a maximum with increasing dilution, and the rule according to which the increase in the conductivity with the dilution is the same for all binary salts. The conductivity of solutions has been investigated at temperatures ranging from the freezing point of liquid sulphur dioxide to its critical point. The molecular conductivity increases at first with the temperature, reaches a maximum at a temperature dependent upon the nature of the dissolved salt, and then decreases with a further rise of temperature, becoming finally zero at the critical temperature, although the salts remain dissolved even at temperatures above the critical temperature. The authors conclude from this observation that electrolytic dissociation in solutions is an essential property of, or conditioned by, the liquid state of aggregation. Determinations of the molecular weight of dissolved salts by the boiling-point method give values higher than the normal, from which it would appear that the molecules of the dissolved salts are to a considerable extent polymerised, or form complex associated molecules containing molecules of the solvent.

THE additions to the Zoological Society's Gardens during the past week include a Macaque Monkey (*Macacus cynomolgus*) from India, presented by Dr. Worley; a Pochard (*Fuligula ferina*), European, presented by Dr. H. S. Jameson; a Smooth-headed Capuchin (*Cebus monachus*) from South America, a White-fronted Capuchin (*Cebus albifrons*), a Hoary Fox (*Canis vetulus*) from Brazil, a Blue-fronted Amazon (*Chrysotis aestiva*), five Giant Toads (*Bufo marinus*) from South America, an American Green Frog (*Rana halecina*) from Central America, two Gangetic Trionyx (*Trionyx gangeticus*) from India, deposited.

OUR ASTRONOMICAL COLUMN.

THE NEW BRUCE SPECTROGRAPH FOR THE YERKES REFRACTOR.—This instrument has been provided from funds supplied in 1899 by Miss Catherine Bruce and the Rumford fund of the American Academy of Arts and Sciences. The arrangement of the various parts has been designed in view of obtaining the greatest possible rigidity and uniformity of temperature, as the principal work for which it is to be employed is the determination of velocities in the line of sight. To this end several departures have been made from ordinary designs. The foundation consists of two castings rigidly connected by a framework of steel tubes, one of these castings, weighing about 200 pounds, being attached to the massive terminal ring of the 40-inch refractor by eight bolts. The collimator tube is firmly attached to this and the second casting, which latter also holds the framework on which the prism train is mounted. It was decided to use three prisms of such angle that the total deviation was 180°, thereby rendering the instrument more compact and free from flexure. The optical train, consisting of the correcting lens, collimating lens, prisms and camera lens, were made by Brashear from formulæ supplied by Prof. Hastings. The correcting lens is 57 mm. aperture, and is so designed that when placed 100 cm. in front of the focus of the 40-inch for λ 4500, the angular aperture of the large lens is not altered. The performance of this lens has been found to be very satisfactory, rendering it possible to obtain a star spectrum of uniform width from λ 4300-λ 4700.

The collimator has a triple cemented lens of 51 mm. aperture and 958 mm. focus.

The first set of prisms, made from Mantois glass, was not satisfactory, and has been replaced by prisms made from glass supplied by Messrs. Schott and Co., of Jena. These are not perfect, but have given sufficiently good results to warrant their adoption. The refracting angles are about 63½°.

Two camera lenses are provided, one being a Zeiss anastigmat, aperture 71 mm., focal length 449 mm., the other a triple cemented lens designed by Prof. Hastings, with aperture of 76 mm. and focus 607 mm.

For the region of H_γ the dispersion of this spectrograph is almost identical with that given by the Mills and Potsdam III. spectrographs.

For temperature control the whole instrument is enclosed in a double-walled case of aluminium; thick felt is packed in the space between the two metal sheets, and a helix of thin wire distributed through this provides a convenient means of keeping the temperature of the prism chamber almost constant for a considerable time. For comparison spectra, electrodes of titanium and iron are used, and also a vacuum tube of helium.

In following, the method devised by Huggins of using the slit plate as a reflector has been adopted, several variations being made to avoid the inconvenience of having the two slit-jaws in different planes with respect to the collimator axis.

An extensive series of preliminary photographs has been taken and reduced, and the instrument is now in use for standard determinations of spectroscopic binaries, &c., which can only be detected by the variable radial velocity deduced from the displacement of spectrum lines (*Astrophysical Journal*, vol. xv. pp. 1-27).

THE STRATIFICATIONS OF HYDROGEN.[1]

THE following pages give the outcome of attempts to prepare pure hydrogen, and experiments on the stratifications exhibited by the purified gas under the influence of an induction current. The researches were commenced in 1884 and have been continued intermittently to the present time.

Strips of palladium foil were charged with hydrogen by the electrolysis of dilute sulphuric acid, a 4-cell Grove's battery being used for one hour. After drying, the palladium strips were put in a glass tube and sealed between the hydrogen generator and vacuum tube. At first, crude gas from the generator was used to wash out the apparatus, and after many fillings and exhaustions—the last to the highest possible point—the generator and tap were sealed off, leaving only the palladium and drying tubes attached to the apparatus. A portion of the palladium was now gently heated; the gauge sank 12 cm., when it was again well exhausted and a little more hydrogen liberated. This was repeated three times, when the tube was exhausted to the stratification-point—about 4 mm.

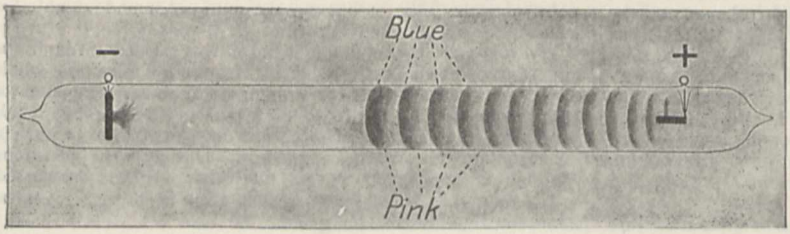


FIG. 1.

Parti-coloured Stratifications.

The strata were twelve in number and of a slightly concavo-convex button-shape, each of a blue colour on the convex side facing the negative pole, and pink on the other side. On eversing the current, the buttons faced round, always presenting

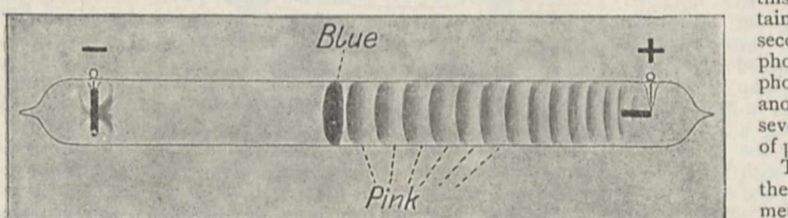


FIG. 2.

the blue face to the negative pole. Examination with a spectroscope showed strong hydrogen lines in the pink parts and both hydrogen and mercury in the blue parts. Fig. 1 shows the appearance at this stage.

The exhaustion was now raised to 2 mm., when the whole of the blue faces of the parti-coloured button suddenly migrated to one bright blue, well-formed button, nearest the negative pole, all the other buttons remaining pink. The appearance is shown in Fig. 2. Round the negative pole an indistinct halo showed both mercury and hydrogen; but on the blue button mercury only was detected, not a trace of even the brightest hydrogen line being there seen. On the pink portions the hydrogen lines were in excess, but mercury could be seen all along the tube.

A slight difference is produced in the purity of the colours of the strata according as aluminium or platinum poles are used. A pair of vacuum tubes was made, one having the usual shaped aluminium poles, the other having platinum poles of a special construction. Each terminal was of double wire, at one terminal bent into the form of a ring and at the other a straight pole. The ends of the wires forming the poles were sealed through the tube close together, but not touching, and terminated in loops outside, so that

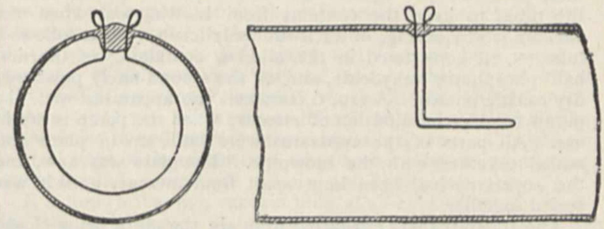


FIG. 3. (Full size.)

they could be raised to red or white heat by connecting them with a few battery cells. The arrangement will be readily understood by reference to the accompanying drawings (Fig. 3). Thus heat could easily be applied during exhaustion, first to one pole and then to the other, even while the induction spark was passing. At first much gas was liberated from the platinum, but by repeated heating, pumping, and passing the spark, all the occluded gas was abstracted, and then the fillings with hydrogen and subsequent operations were commenced.

The general plan of the apparatus is shown in the drawing (Fig. 4). At the end furthest from the pump is the hydrogen generator, A, consisting of a U-shaped tube filled with dilute sulphuric acid, having in one leg a plate of amalgamated zinc, B, and in the other a sheet of platinum, C. Both the platinum and the zinc are connected metallically to platinum wires sealed through the glass. A funnel with a stopper, D, sealed to the outer limb of the generator admits dilute acid when required. A tap, E, on the other limb enables the reservoir of hydrogen to be disconnected from the rest of the apparatus. Following this tap is a battery of three tubes, one, F, containing small lumps of dry caustic potash, the second, G, and the third, H, tubes containing phosphoric anhydride. Between the second phosphoric anhydride and the vacuum tube is another tube having sealed on to it, comb-like, seven projecting arms, J J, each containing a strip of palladium foil saturated with hydrogen.

The vacuum tube, K, is eight inches between the terminals and three-quarters of an inch diameter; it comes next to the comb, and then between it and the pump is a battery of tubes, each twelve inches long, to keep out the mercury. The first tube, L, is divided by a constriction in the middle, and contains, in the half next the vacuum tube, bright metallic copper, in the other half sulphur. The three next tubes, M, M, M, contain sulphur, but in the middle of each are placed a few grains of iodine separated from contact with the sulphur by a

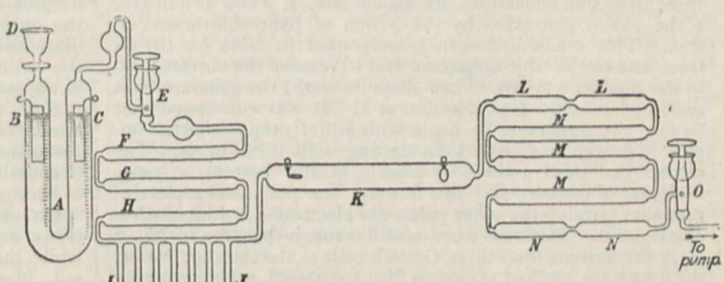


FIG. 4

plug of asbestos on each side. The sulphur is prepared by keeping it fused at a temperature a little below its boiling-point till bubbles cease to come off, so as to get rid of water and

[1] Paper read at the Royal Society on February 6 by Sir William Crookes, F.R.S.

hydrogen compounds. It is then allowed to cool, and is pounded and sifted so as to get it in the form of granules, averaging a mm. in diameter. Ignited asbestos is packed at each end of the tubes to keep the contents from blowing out when the vacuum is proceeding, or air is suddenly let in. Next follows a tube, N, N, constricted in the middle, containing in the first half phosphoric anhydride, and in the second finely powdered dry caustic potash. A tap, O, connects the apparatus with the pump to prevent diffusion of mercury when the pump is not in use. All parts of the apparatus were built up in place and sealed together with the blowpipe. The glass was new, and the apparatus had been kept apart from mercury until it was sealed together.

The apparatus was exhausted from air, the tap E being closed and D open. Electrolysis was then commenced (D being closed), and the tap E was slightly turned until the escape of hydrogen into the apparatus was equal to the speed of its generation. The apparatus was filled, and several times exhausted, until no improvement in the spectrum or stratifications could be seen. The electrolytic cell was then sealed off at a narrow constriction between the first potash tube, F, and the phosphoric anhydride tube, G. After good exhaustion, one of the branch tubes of palladium was heated, when the gauge sank several centimetres. Exhaustion and refilling from fresh palladium were repeated until no alteration was detected in the appearance of the strata. Then, for the first time, I obtained hydrogen strata showing no blue, either throughout the tube or concentrated in front, whilst the most careful examination showed no mercury. The stratifications were all pink, and showed the hydrogen lines strongly.

Many disadvantages were noticed in the apparatus just described, the chief being the danger of introducing more impurities than were kept out by the copper, sulphur and iodine tubes. The palladium method of introducing hydrogen was not altogether satisfactory, as only small quantities could be dealt with, and occasionally at a critical point the store was exhausted. Also, the electrolytic generator of hydrogen was too small. It was decided, therefore, to devise and fit up an entirely new piece of apparatus. In this another method was used for keeping out the mercury. It had been noticed that the diffusion of mercury from the pump proceeded the more slowly as the distance from the pump and the narrowness of the connecting tubes increased. It was thought that by introducing a long narrow spiral between the pump and the apparatus, one complicated system of tubes, with their attendant dangers, could be removed; the result showed this supposition to be correct. Two vacuum tubes were employed, one having aluminium, the other platinum terminals. The hydrogen generators were increased in size and number, and were so distributed that they could be sealed off one after the other during the progress of the experiment.

Stratifications in Pure Hydrogen.

The arrangement of the apparatus is shown in Fig. 5. The three hydrogen generators are called Nos. 1, 2 and 3. In No. 1 the gas is generated by the action of hydrochloric acid on zinc. This crude hydrogen is only used to drive out the air from the rest of the apparatus and to remove the air dissolved in the liquids. When it had done its work, the generator was sealed off between Nos. 1 and 2, at A. It was considered that having the apparatus to begin with full of even somewhat impure hydrogen was better than starting with it full of air. The second and third generators contain at the bottom a pasty amalgam of mercury and zinc forming one pole, and a piece of platinum forming the other pole; the electrolyte is dilute hydrochloric acid. Platinum wires sealed through the sides of No. 3 carry the current from three Grove's cells to the interior. After the apparatus has had generator No. 1 removed, a large quantity of hydrogen is passed through from the second generator, with the object of replacing the impure hydrogen by some of a purer quality. When No. 2 is exhausted, it also is sealed off at B, leaving only the third generator with its drying tubes connected with the apparatus. Before sealing off No. 2, filling and exhausting is carried on until the hydrogen shows no impurity when spectroscopically examined in a capillary tube attached to the vacuum tube. The gas from the first and second generators bubbles first through strong caustic soda, C, C, C, to remove any acid carried over from the generators, then through strong sulphuric acid, D, to take away the bulk of the moisture and thus save the drying tubes; it then passes through the purifying arrangements more especially connected with the third generator. Having sealed off Nos. 1 and 2, gas is evolved from No. 3 generator. Hence it passes through strong sulphuric acid in the tube H; then over a tube filled with granulated caustic soda F; and next through a tube, G, tightly packed with phosphoric anhydride. H and I are two taps, having a reservoir, K, between them. When full of gas, H and I are closed, and the tubes L and M, after having been exhausted to a high point, can then be fed with limited amounts of pure dry hydrogen by slightly opening tap I and closing it when equilibrium is restored between L, M and K. N is a spiral of narrow glass tubing immersed in a beaker of ice and water. At O is a tap to keep mercury from diffusing into the pump if the apparatus has to be left all night. The vacuum tube, L, is provided with aluminium poles and the tube M has the platinum poles made double for heating purposes, as shown in Fig. 3.

Hydrogen from the first generator was passed through the apparatus for two hours, when it was sealed off. The whole apparatus was exhausted to a high point and No. 2 generator was set to work. Hydrogen was passed several times at full pressure through the apparatus for one or two hours and then exhausted to the stratification point. During these operations the platinum terminals of one of the vacuum tubes were heated to full redness and the current was kept on both tubes for some hours to drive off occluded gases.

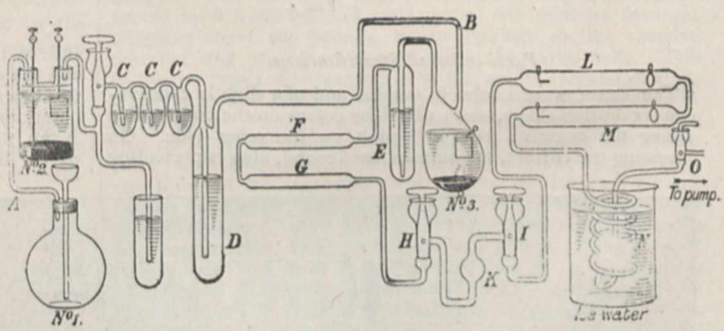


FIG. 5.

Finally, the second generator was sealed off and hydrogen used from the remaining generator. After much washing out with hydrogen at the ordinary pressure, exhaustion and re-filling were continued, and finally the reservoir K was filled, both taps, H and I, being closed. The tubes were highly exhausted to the non-conducting point, and tap I opened and then closed, so as to introduce a little hydrogen. H was then opened and again closed, so as to equalise the pressure in I, and exhaustion proceeded to the stratification point. At first the strata were irregularly coloured with a suspicion of blue on one face, but as the operations just described were continued, the blue faces disappeared, the stratifications assumed a pure pink hue and showed the hydrogen spectrum alone; no mercury was detected in any part of either tube.

From the first to the eighth filling the strata were pink with a trace of slaty blue colour on the faces next the negative pole. From the tenth filling the blue faces disappeared, and after the twentieth filling no trace of blue could be seen and the spectrum of hydrogen alone was visible.

On examining the spectra of the stratified gas in the two tubes, each showed strongly the line spectrum of hydrogen; but while the spectrum in the platinum-poled tube showed pure red, blue and green lines on a black ground, that in the aluminium-poled tube showed in addition the fainter hydrogen line spectrum in the yellow and orange. This result may be due to the greater surface exposed by the aluminium poles; it was not further examined.

Having at last succeeded in getting hydrogen free from mercury, experiments were instituted to verify the inference that the blue components of the blue and pink strata usually attributed to hydrogen were really due to the presence of a trace of mercury.

Origin of the Blue Component of Parti-coloured Stratifications.

I used an apparatus similar to the last, but with only one generator. If my idea was correct, that the mercury in the course of a few hours diffused into the hydrogen tube from the pump when it was not at work, there ought to be an access of blue faces to the pink buttons after the exhausted apparatus had been at rest. After filling with hydrogen and exhausting several times, a hydrogen vacuum was obtained showing no blue faces to the pink strata. The apparatus was then left all night and the stratifications examined next morning. The blue colour to each face was now unmistakably visible. The refilling with hydrogen and exhausting was then continued. It was not possible in this way to get the tube entirely free from mercury, although it got less and less, as shown by the diminution of the blue faces.

Occasionally, when no mercury was present, a faint blue edging to some of the front pink strata was seen. This blue was too faint to show lines in its spectrum. After much searching, the blue tint was traced to the phosphoric drying tubes. A clean tube was taken for stratifications and sealed to the apparatus used in the last experiments. The whole was exhausted to a high point, and one of the phosphoric anhydride tubes was gently heated with a gas flame, the current kept going. Instantly a flood of blue light swept through the tube, and when concentrated in a narrow constriction the light showed a complicated spectrum which was not recognised: none of the characteristic lines of the phosphorus spectrum could be seen in it. The tube was cleared of the blue colour by introducing hydrogen and pumping it out a few times, and then hydrogen was introduced and exhaustion continued to the stratification point. The strata now were pink, with no appearance of blue. Warming the phosphoric anhydride tube at once reproduced the faint blue edging to the pink discs. This blue colour was different both in tint and intensity to the blue colour produced by mercury, but it was too faint to show a spectrum except in the constricted part.

It is of importance to ascertain whether the body producing this blue colour can be removed from the phosphoric anhydride. The drying tube was again heated to the subliming point of the anhydride, hydrogen passed in, and the pump worked until the vacuum was almost non-conducting. The heating, passing in hydrogen and pumping were several times repeated, the impurities diminishing each time. Ultimately a point was reached when, the tube being non-conducting, heating the phosphoric anhydride did not communicate any gas to the vacuum tube. At this stage the phosphoric anhydride still retained unimpaired its affinity for water. In any accurate experiment, therefore, the phosphoric anhydride tubes should have a preliminary heating in a vacuum to eliminate the impurity. This may be done with several tubes at a time, when they can be sealed at each end and preserved for future use.

It is thus seen that this blue glow is due to some impurity in the phosphoric anhydride. Likewise I have shown from the examination of its spectrum that it is not due to phosphorus. The glow probably is due to some intermediate oxide of phosphorus. In any accurate work with the mercury pump, where phosphoric anhydride is used as the drying agent, this source of impurity must not be overlooked.

An addition to the apparatus was made, a supplementary tube sealed on containing a grain of corrosive sublimate. This was used as being non-volatile at the ordinary temperature, but easily vaporised by heat. The experiment last described was continued, and immediately after the phosphoric blue edge appeared fresh hydrogen was let in and exhaustion continued till the faint blue was eliminated. The mercury salt was then heated, when immediately a rich blue edging appeared on the face of each pink stratification and the yellow lines of mercury shone out distinctly. Mercury blue is of a fuller colour than that of the phosphoric blue.

Conclusions; Chiefly Theoretical.

The phenomenon of blue faces on the pink discs is probably due to some such action as the following:—At the exhaustion necessary to give stratifications, there is a wide dark space round the negative pole. Here the negative electrons (radiant matter), issuing from the pole with enormous velocity, have sufficient energy to clear a space in front of them to a distance varying with the degree of exhaustion.

Dr. A. Schuster considers that the discharge through mercury vapour in a vacuum tube, when quite free from air, will not give rise to stratifications, or to the dark negative space.[1] My own experiments (*Journ.* of the Inst. Electrical Engineers, vol. xx. p. 44) show that the dark space will form in pure mercury vapour. Whichever view may be correct, there is no doubt that if stratifications in mercury vapour are not altogether unknown, they are much more difficult to produce than similar phenomena in hydrogen or other diatomic gases. At a certain critical stage of the exhaustion, when both hydrogen and mercury are present, I obtain both mercury and hydrogen strata.

It is known that in a vacuum tube, at an exhaustion approaching the stratification-point, any slight obstruction, such as constriction in the tube, or a series of wires sealed in, will cause luminous strata to hang round the obstruction. In a similar way, the hydrogen strata afford an anchorage, as it were, for the mercury, each hydrogen luminosity having a little blue glow of mercury hanging on to it; whereas, were there no hydrogen, no mercury stratifications would be seen.

The pink and blue luminosities show where the electrons and gaseous atoms meet; when the speed of the electrons is suddenly diminished, the shock throws the atom into greater vibration, which, being communicated to the ether, produces vibrations of definite wave-lengths, constituting the special spectrum of the atom. The dense mercury atom is not driven back so much as the lighter hydrogen atom—hence the blue front to the pink buttons. A very little difference in the exhaustion suffices to break the adhesion between the mercury and the hydrogen; then the mercury vapour diffusing along the tube meets the electrons from the negative pole and is swept back to the head of the hydrogen strata, and becomes apparent as a single button of blue light.

Radiant Matter. Electrons.

I have spoken of "radiant matter" and "electrons" as if they were identical. Nearly twenty-five years ago I was led by experiments in highly rarefied tubes to assume the existence of matter in an *ultra-gaseous* state. Later, in a lecture delivered before the British Association at the Sheffield Meeting, 1879 (*Chemical News*, vol. xl. pp. 91, 104, 127), I first used the expression "radiant matter," or matter in the ultra-gaseous state, to explain the novel phenomena of phosphorescence, trajectory, shadows, mechanical action, magnetisation and intense heat. "In studying this fourth state of matter," I said, "we seem at length to have within our grasp and obedient to our control, the little indivisible particles which with good warrant are supposed to constitute the physical basis of the universe. We have seen that in some of its properties radiant matter is as material as this table, whilst in other properties it almost assumes the character of radiant energy. We have actually touched the borderland where matter and force seem to merge into one another" (*Chemical News*, vol. xl. p. 130).

In twenty-five years one's theories may change, although the facts on which they are based remain immovable. What I then called "radiant matter" now passes as "electrons," a term coined by Dr. Johnstone Stoney, to represent the separate units of electricity, which is as atomic as matter. What was puzzling and unexplained on the "radiant matter" theory is now precise and luminous on the "electron" theory. Thus my early hypotheses fall into order by the substitution of one expression for the other. A chemical ion consists of a material nucleus or atom of matter constituting by far the larger portion of the mass, and a few electrons or atoms of electricity. The electrons are the same as the "satellites" of Lord Kelvin and the "corpuscles" or "particles" of J. J. Thomson.

Electrons probably leave the negative pole with a velocity nearly uniform, modified to a considerable extent by the degree of exhaustion, and to a less extent by the electromotive force behind them. Many experiments—the details I must leave to a future occasion—show that the liberated electrons do not behave as a gas, *i.e.* they have not properties dependent on inter-collisions, mean free path, &c.; they act more like a fog or mist, are mobile and carried about by a current of air to which they give temporary conducting powers, clinging to positively electrified bodies and thereby losing mobility, and settling on the walls of the containing vessel if left quiet.

[1] Dr. A. Schuster, "Experiments on the Discharge of Electricity through Gases," *Roy. Soc. Proc.*, vol. xxxvii. p. 318.

On the other hand, the crowd of hydrogen or mercury atoms, by virtue of molecular motion and inter-collisions, act as gases. Whilst their *mean* free paths are conditioned by the degree of exhaustion, there may be amongst them a certain number of *actual* free paths differing widely on each side of the mean. Under the influence of the electromotive force, and at the right degree of exhaustion, these atoms arrange themselves in groups,[1] while the rushing swarm of electrons driven from the negative pole meet them and render them visible. According to J. J. Thomson, the mass of an electron is about the 1/700th part of that of the hydrogen atom, and as these masses start from the negative pole in a vacuum tube with a velocity of the order of half that of light, it is easy to see that their heating, phosphorescent and mechanical power must be stupendous.

The basis of the electron, as I foreshadowed in 1879 in the case of radiant matter, is probably the same in all cases—the protyle from which the chemical atoms were assumed to be formed.

On the two-fluid theory, the electrons constitute free negative electricity, and the rest of the chemical atom is charged positively, although a free positive electron is not known. It seems to me simpler to use the original one-fluid theory of Franklin and to say that the electron is the atom or unit of electricity. Then a so-called negatively charged chemical atom is one having a surplus of electrons, the number depending on the valency, whilst a positively charged atom is one having a deficiency of electrons. Differences of electrical charge may thus be likened to debits and credits in one's banking account, the electrons acting as current coin of the realm.

SCIENTIFIC WORK OF THE GERMAN ANTARCTIC EXPEDITION.[2]

THE head of the German Antarctic Expedition, Prof. Dr. Drygalski, has sent from Cape Town to the home authorities a number of full reports on the work which had been carried on by the expedition up to the date of their despatch. As is well known, the ship, which had been specially built for the expedition, was long overdue at Cape Town, and her protracted non-appearance gave rise to some anxiety. We give the following extracts from the official report, which will shortly appear, in order to furnish evidence of the activity of the staff, and of the reasons for the great protraction of the voyage.

In the scheme of operations for the expedition, it had been arranged that visits to two land stations should be made during the voyage to Cape Town, in order to determine, by fresh comparisons with the absolute magnetic elements at those land stations, the changes in the magnetic character of the ship since its determination at Kiel before sailing. The magnetism of a new ship is always subject to changes in course of time, but these changes are more especially caused by change of magnetic latitude as the ship passes from one hemisphere to the other. With this object, the following places were selected as apparently desirable:—The Cape Verdes or Madeira, north of the magnetic equator, and Bahia or Ascension to the south of it.

After consultation with the magnetician of the ship, Dr. F. Bidlingmaier, I had selected Porto Grande in St. Vincent and Ascension. If, for any reason, Ascension proved to be inaccessible, it seemed advisable to adopt the usual plan, on board ship, and determine the deviation by swinging the ship on eight different courses in the open sea. During our stay at Porto Grande, which lasted until September 11–16, the magnetic observations were our principal business, and we succeeded in determining, on board the ship, the deviations in the Magnetic Declination, Total Force, and in Horizontal and Vertical Force due to her magnetism.

I myself landed, with two assistants, and set up a tent near the spot where the shore magnetic observations were being carried on, in order to secure time observations to rate our chronometers and watches, and also to make some observations of the force of gravity. Owing to the weather, we could make no astronomical observations.

My orders for the next part of the voyage were to cross the equator on the 18th meridian, and then to make for Ascension. The object of the first position was to verify the sounding of 7370 metres (4030 fathoms) [the greatest depth on the line], which had been obtained by the French man-of-war *La Romanche* in 0° 11′ S. and 18° 15′ W. As this figure is not mentioned on the British charts of soundings, nor in the recent critical representation of sea depths, by Prof. Dr. Supan, I therefore wished to trace its possible connection with the great depths of the Brazilian basin.

The visit to Ascension was to attain the objects above named. It was evident enough that the carrying out of this plan would present some difficulties, for the usual sailing track to the Cape (which was best for our ship, owing to the low power of her engines, which would not allow of steaming against the S.E. trade with its accompanying sea) crosses the equator far to the westward, probably as far as the 25th meridian. A visit to Ascension would entail our steering a south-easterly course immediately on leaving the Cape Verde, so as to be able to make a south-westerly course to the island under sail. The course indicated was to be first tried and tested as to whether it would take too much time. We crossed the belt of calms under steam, between the two trade winds. In this swell the *Gauss* rolled, at times very heavily, so that much glass or other breakable articles in the laboratory came to grief, while the ship, under sail, even with a stiff breeze and a good deal of sea, had been remarkably steady. This swell retarded our progress considerably, as of course our speed was greatly reduced. This was aggravated by increased fouling of the bottom. As the ship was very low in the water, the screw well, through which the screw and rudder could be lifted, on meeting ice, so as to preserve them from damage, may have contributed to the prolongation of the voyage. In short, we proceeded very slowly along the prescribed track, where the wind failed us, and the currents at least gave no help, though the engines worked perfectly, and gave promise of a very satisfactory performance whenever we should come into a state of sea checked by the presence of ice.

All these impediments retarded us with enhanced insensity when we met the S.E. trade on the line. This was very fresh (and we should have liked to have had a similar force in the N.E. trade), but we could make no use of it, as it was dead ahead on our course for Ascension, and it brought with it a trying swell and current. The rate of the ship got less and less, and at last stopped entirely on October 5. In these circumstances, as time was getting on (we crossed the line a few days after the entry of the sun into south declination on October 1, so that we ran directly from the northern into the southern summer), it seemed therefore desirable to reconsider our plan and give up the Ascension visit entirely, and so on October 6 I decided to do this and use the existing S.E. trade for a run to the Cape, starting on that day. As soon as we changed our course we made at once a speed of six or seven knots. On October 7 we disconnected the engines and made sail, but the wind did not last. On October 9 the S.E. wind died away, and these light winds continued, with some slight exceptions, up to Cape Town. The *Gauss* always made very short daily runs, so that we had a very long passage. The light winds and fair weather were the cause, as we had only one storm, November 18–20, just at the end of the voyage. We were naturally obliged to husband our coal so as not to lighten the ship too much.

On October 30, the after steam capstan was connected with Prof. Vanschöffen's vertical net, which was at a depth of

[1] In an address delivered before the Institution of Electrical Engineers, January 15, 1891, I gave an outline of a theory of stratifications in rarefied gases. The following quotation renders my meaning clear:—"If, in any much-frequented street, at some time when the stream of traffic runs almost equally in both directions, we take our stand at a window from which we can overlook the passing crowd, we shall notice that the throng on the footway is not uniformly distributed, but is made up of knots—we might almost say blocks—interrupted by spaces which are comparatively open; we may easily conceive in what manner these knots or groups are formed: some few persons walking rather more slowly than the average rate slightly retard the movements of others, whether travelling in the same or in an opposite direction. Thus a temporary obstruction is created. The passengers behind catch up to the block and increase it, and those in front, passing on unchecked at their former rate, leave a comparatively vacant space. If a crowd is moving all in the same direction, the formation of these groups becomes more distinct. Hence mere differences in speed suffice to resolve a multitude of passengers into alternating gaps and knots. Instead of observing moving men and women, suppose we experiment on little particles of some substance, such as sand. If we mix the particles with water in a horizontal tube and set them in rhythmical agitation, we shall see very similar results, the powder sorting itself with regularity into alternate heaps and blank spaces. If we pass to yet more minute substances, we observe the behaviour of the molecules of a rarefied gas when submitted to an induction current. The molecules here are free, of course, from any caprice, and simply follow the law I seek to illustrate, and though originally in a state of rampant disorder, yet under the influence of the electric rhythm, they arrange themselves into well-defined groups or stratifications."—*Journ.*, of the Inst. Electrical Engineers, vol. xx, p. 10.

[2] Based upon an Article in *Der Tag*, Berlin, January 25.

2000 metres, and above it hung my deep-sea thermometers and five or six buckets, at the depth of 1500 metres. As each bucket came up, Dr. Gazert and Dr. Philippi speedily emptied it of its contents to search for bacteria and determine the amount of contained gas. Dr. Bidlingmaier, on the captain's bridge, regulated his registering apparatus in the meteorological screen, while Captain Ruser, beside him, kept the ship heading the swell and watched that the deep-sea lines should not get foul and that the ship should not overrun them. The chief engineer, Stehr, on the after bridge watched the sounding apparatus with me. The first officer looked after the line as it came up and quickly dismounted the attached instruments. Vahsel saw to the running of the windlass itself, and Ott, in the small dinghy, picked up a huge albatross which Dr. Gazert had shot, and which was at once dissected by the practised hands of Dr. Werth. Then came up Dr. Stehr's question as to how many wheels were running on board at once, without actually counting them.

On Saturday, November 23, we reached Cape Town, having made some magnetic observations near the coast. On Saturday, December 7, the expedition will start again.

I can only say, in conclusion, that we shall never forget the warmth of the reception we met with, not only from the Imperial Consul-General von Lindequist, the members of his staff and the German colony, but also from the officials and scientific men of Cape Town, which rendered our stay there particularly pleasant.

THE USE OF ANATOMICAL CHARACTERS IN THE IDENTIFICATION OF WOOD.[1]

THE chief contributions to the study of the secondary wood of plants have been made by students of forestry, amongst which the names of Nördlinger, Hartig, Brandis, Gamble, and of many men connected with the Indian Forestry Department, deserve our respect. The school of Radlkofer (especially Solereder) has done good work in connection with the structure of the primary wood, which throws many sidelights upon that of the secondary wood, yet there is much less help to be derived from their studies than one would suppose, because there is frequently much difference in the structure of the two classes of tissue.

The grouping of the vessels and the medullary rays and the arrangement of the wood-parenchyma are frequently so characteristic that various genera can be recognised by a glance at the transverse section, *i.e.* horizontally as the tree stands; and, further, it is by no means rare to find the same structure running through a whole genus or, less frequently, through a whole order. A hundred genera could be cited which exhibit a strong family likeness, and of the Proteaceæ and Sapotaceæ it may be said that the description of the structure of the wood of one species will practically serve for the whole order. On the contrary, there are orders which appear to consist chiefly of exceptions, as in the case of the Celastraceæ, where it is difficult to find two genera with any important feature in common. The structure of the woody portion of cryptogams has been employed for years in the study of fossil plants; that of the monocotyledonous trees and of the conifers is notoriously uniform, and is as sure a guide to their position in the natural system as any external character. Why then should not the same rule apply to the angiospermous dicotyledons, and for what reason should the thread be lost as soon as we pass from one division of the vegetable world to another? It seems a by no means extravagant idea that, inasmuch as it is quite indifferent to the welfare of a plant what the structure of its woody portion may be so long as it performs the mechanical duties imposed upon it, ancestral traits should be preserved undisturbed in the wood more than in any other part.

Ignoring this debatable question there is no doubt whatever of the economic importance of this study. There are not only so many kinds of timber in use in Europe and elsewhere, but there are great numbers which are destined to become useful, together making a variety with which no timber dealer can keep *en rapport* by the old method of rule of thumb. It is still more difficult in the colonies and in new countries to tell one wood from another, because the number of persons possessing the necessary training is smaller than at home. The popular and vernacular names are in many places so frequently duplicated or misapplied that they are useless as guides unless the structure of the wood be taken into account. Instances could be multiplied in which wrongly named timbers have been referred to their proper titles, and of inquiries for unknown woods being directed into the proper channel, and of cases in which attempted deception has been frustrated by the anatomical method.

For practical purposes it is rarely necessary to use high powers of magnification or to study the sculpture upon the walls of the cells. A pocket lens or a two-inch objective will frequently suffice to display the special character of the structure. If higher powers be used this individuality, as I may call it, is lost, as it is dependent upon the arrangement or complex of the elements. For instance, the radial or tree-like arrangement of the vessels in the wood of all the trees of the genus Quercus is recognisable by the naked eye, but it fails to be striking when viewed under a half-inch objective. This particular feature may be traced through the genera Corylus, Castanea, Ostrya, Castanopsis and Carpinus, but not in Fagus. The concentric undulating lines of vessels characteristic of the elms are also usually visible to the naked eye and can be traced in every species of Ulmus and, in a modified form, in Celtis, also in Ficus, Morus, Artocarpus, Maclura and Urtica.

FIG. 1.—Oak. Transverse section × 3½.

It may at once be conceded that anything like a natural system of classification of woods by their structure is quite impossible at present. There are too many glaring exceptions and there is too little recorded information. Out of sixteen species of Caprifoliaceæ examined,[1] fifteen have the same type of structure, while the remaining one, *Viburnum Tinus*, L., is quite different; while out of nineteen species of Celastrus there were found no less than seven distinct types of structure.

Nevertheless, amongst such a number of different woods a guide to enable one to trace the name of any wood is a crying need, and several authors have attempted with more or less success to satisfy it. There are several by which the European woods may be identified, notably those by Mathieu, Hartig, Schwartz and Nördlinger, that of the latter embracing exotic woods also, to the number of 1100. Unfortunately, Nördlinger, whose work is otherwise unrivalled, relies upon the definiteness or indefiniteness of the boundary of the year's growth of wood in too great a degree, hence the student is led astray. Alfred Ursprung has recently shown how elusive this

[1] Based upon a paper read before the Society of Arts on December 4, 1901, by Mr. Herbert Stone.

[1] Sambucus, 2 species. Viburnum, 6 species. Lonicera, 8 species.

character is. From the examination of some 1500 species I am convinced that the character of the medullary rays (which, by the way, are anything but medullary in the secondary wood) is the most constant feature and should form the basis of an artificial key, but it separates the genus Betula, the rays of which are but a millimetre high on a vertical section from Alnus, where they may run to inches, and it cuts the Leguminosæ into two halves, one of which has bold spindle-shaped rays in transverse section (Ulex, Cytisus, &c.), while in the other the rays seem to meander amongst the vessels like so many limp threads (Mimosa, Gleditschia, &c.).

Nevertheless, a useful key may be constructed by first distinguishing those woods with two kinds of rays (many Cupuliferæ) from those having but one. The latter then fall into two groups, one having rays which have intervals between them of not less than the transverse diameter of the largest pores present, the other conversely having the intervals between the rays never greater than the pore-diameter, *i.e.* the rays diverge and run round or avoid the pores. These two types of rays are very clearly marked and have quite different aspects. The arrangement of the vessels or pores can then be usefully employed, as the concentric radial, tree-like or undulating groups, or uniform distribution of the pores is very constant in many genera, as are

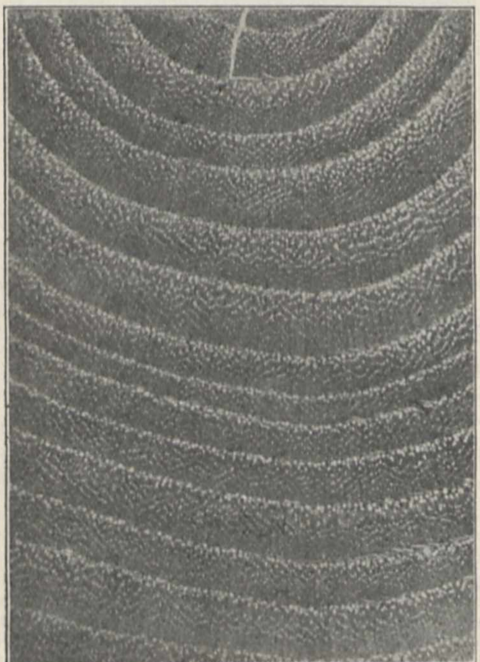


FIG. 2.—Common elm. Transverse section ×3½.

also the equally varied forms assumed by the soft-tissue (wood-parenchyma), which comes next in order of importance. It would be out of place here to go into further detail, and it need only be pointed out that by following this sequence all members of the same genus except the aberrant forms fall together into the same ultimate group, which is not the case with Nördlinger's or any other key that I have used.

Many groups, or even whole genera, are so similar in structure that their species can only be distinguished by long acquaintance, *e.g.* Fraxinus, Acer, &c., and it is then necessary to have recourse to other features, such as the specific gravity, colour, smell, taste, hardness, behaviour with certain reagents, colour of their solution with water and alcohol, &c. Frequently these are so pronounced that a single feature may be sufficient to describe a species, as, for example, the offensively powerful cheese-like smell of *Goupia tomentosa* and the flinty hardness of *Lignum vitae*, hence it has often been urged that if a wood can be so readily identified by such simple means, why employ a more complicated and less accessible method. No one underrates obvious characters, but there are thousands of species, hundreds of which are employed in the arts, that have no pronounced feature of this kind to distinguish them. The value of the anatomical characters to the systematic botanist and to the trader is, however, in inverse proportion. The closer the resemblance in structure between the members of the same group the stronger the claim for a place in classification. On the other hand, the greater the dissimilarity the easier becomes their discrimination for commercial purposes.

CONFERENCE ON SCHOOL GARDENS.

A CONFERENCE on school gardens was held under the auspices of the Berkshire County Technical Education Committee at Reading College on Saturday. Mr. T. G. Rooper, one of His Majesty's inspectors of schools, read a paper on "School Gardens in England and in Germany," giving an account of those he has helped to institute in this country and others which he visited on the Continent. He dwelt, too, upon the provision made in Germany at the Pomological Institute for training elementary teachers, and one of his most interesting points was with regard to them. They are not, as here in England, expected in return for tuition, maintenance and travelling expenses, to attend courses of instruction during well-earned holidays, but they have the additional privilege of working at the Institute during term time, a substitute being paid to take their duty.

English school gardens, though at present comparatively few in number, are on all sides acknowledged to be the most practical yet instituted. Except in the case of those attached to continuation schools, no attempt must be made to utilise them for the technical teaching of gardening or otherwise than as mere training, mental and manual. A point obvious enough that was touched upon was that inspectors of schools should know something of horticulture if they are to report on school gardens and these are to be instituted in larger numbers. The importance of it is that, with very few exceptions, the inspectors are not at all well versed in the subject. County Councils cannot spend money directly upon elementary schools, but training of teachers they can arrange for, they can hold conferences such as the one here discussed, and their horticultural instructors may, and do, without breaking the law, give advice on the laying out of school gardens. Mr. J. C. Medd, in the course of his remarks, alluded to the Nature-Study Exhibition, with a view to holding which in London during next summer an association has just been formed. At this, which if it comes about will be greatly due to Mr. Medd's efforts, garden produce that may be in the proper condition at the time will no doubt be welcomed. Sir John Cockburn, lately Premier and Minister for Education in South Australia, is the chairman of the executive committee. Sir John, speaking at the Conference, alluded to "Arbor Day," upon which everyone in the antipodes who can plants a tree. The idea, one might say, is borrowed from America and is a very good one.

The difficulty of getting proper time for practical work was also touched upon by Sir John Cockburn, who said that, although one hour was all he could obtain at first, nevertheless, before he left South Australia, schools had been started in which only half the time was devoted to theoretical instruction.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—At the 232nd meeting of the Junior Scientific Club on Wednesday, February 12, two papers were read, viz. "Colour and Chemical Composition," by Mr. S. A. Ionides, Balliol College, and "The Centrosome," by Mr. A. D. Darbishire, Balliol College.

By his will, Sir J. H. Gilbert, F.R.S., who was Sibthorpean professor of rural economy from 1884–90, and who died on December 23, 1901, bequeathed the portrait of himself by his brother, Josiah Gilbert, to the University of Oxford, to be placed in the library of the Sibthorpean professor of rural economy.

DR. F. T. TROUTON, F.R.S., of Trinity College, Dublin, has been appointed Quain professor of physics in University College, London, in succession to Prof. H. L. Callendar, F.R.S.

DR. W. H. WILLCOX has been appointed deputy lecturer in hygiene at Bedford College for Women, on the resignation of

Dr. W. C. C. Pakes, who has been appointed bacteriologist to the Transvaal Government. The council has resolved that, in order to keep a permanent record of the legacy left to the college by Mrs. Morton Sumner, the lecturer in geology be hereafter called the Morton Sumner lecturer in geology.

THE papers read at the recent conference of science teachers, arranged by the London Technical Education Board, are appearing in the *Technical Education Gazette*, with reports of some of the speeches. The January number of the *Gazette* contains addresses on the teaching of hygiene, by Miss A. Ravenhill; mental school hygiene, by Dr. F. Warner; and the teaching of natural history, by Mr. F. E. Beddard, F.R.S.

THE Technical Education Board of the London County Council report that the reorganisation of London University is already having a marked influence for good on the polytechnics and other institutions. The advanced classes in science and engineering are being revised and brought up to a higher standard, gaps in the curriculum are being filled up, and more students are being induced to enter upon systematic courses of study, extending over three or four years, instead of attending isolated classes. Complete degree courses, under teachers of the University, will shortly be available for evening students at several of the polytechnics. The due recognition of engineering and higher commercial subjects was provided for by the establishment of separate faculties, and the Senate has now approved courses of study in which students will proceed to the degrees of B.Sc. and D.Sc. The regulations for the economic or commercial degree enable it to be gained in such subjects as the history, principles and organisation of banking, insurance, railway and shipping transportation, international commerce, local government, statistics, &c. By means of the Council's aid, the Senate has now determined on (1) the organisation of an institute of advanced chemistry, both organic and inorganic, at one centre; (2) the provision of advanced teaching in engineering at two centres; (3) the systematic organisation of the teaching of modern languages at all the University centres, including the polytechnics, and beginning with German; (4) the provision of a professorship of education in connection with the Council's proposed day training college for teachers; and (5) the appointment of University teachers in economic history and theory, commercial geography and history, banking, statistics, foreign trade, &c.

SCIENTIFIC SERIAL.

Bulletin de l'Académie de Sciences de St. Pétersbourg, 5th series, vol. xii.—On the compound (so-called stationary) radiants of shooting stars, by Th. Bredikhine (in French). The supposed existence of stationary radiant points (or radiant points of long duration) is an obstacle against all more or less admissible theories of shooting stars. Taking advantage of the 918 meteoric orbits calculated by J. Kleiber in 1891, and of subsequent data, the author concludes that each stationary (or long duration) radiant consists of several individual radiants, even when these radiants do not much differ from each other in their dates; this means that each stationary radiant is a compound radiant which originates from several individual radiants, each of which has its own position in space and its own origin, and all of which are intersected by the orbit of earth. Thus, in the well-known radiant of β Persei he finds "thirteen or fourteen different orbits, *i.e.* as many different streams" (p. 102). The author examines next the theories of Profs. H. H. Turner and A. S. Herschel, and concludes that "the deductions of Prof. Turner are only admissible under the impossible supposition that the earth moves with a uniform speed along a straight line. But if the theory itself is inconsistent, its secondary complications, such as the spinning of the meteoritic stream, the resisting medium, &c., have no more signification" (p. 115). Applying his explanation next to the polar stationary radiants of Mr. Denning, the author shows that in the radiant ζ Draconis (No. 36 of catalogue A), one may recognise "twelve different individual streams (twelve comets) apparently composing one single stationary radiant." The author's final conclusion is:—"A stationary radiant does not originate from a single individual stream or from one single comet; it must be named a compound radiant, because it is produced by several comets or independent streams. The phenomenon is so simple that all complicated and artificial theories are useless and superfluous. . . . Thanks to the numerous and careful observations of Mr. Denning, the phenomenon has lost its supposed individuality and has become decomposable and explicable."—On photographic observations of the satellite of Neptune at Pulkova, by S. Kostinsky (Russian; with a plate).—Report on zoological researches at Sebastopol in 1899, by A. Kovalevsky: hypodermal fertilisation with the leeches; on *Batracobdella latastii*; on *Hedyle Tyrtowii* (n.sp.); on *Pseudovermis paradoxus*, Periasl.—On faint lines in stellar spectragrams, by A. Belopolsky.—On a MS. in Coptish language attributed to Dionysius Areopagita, by Oscar Lemm.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, January 23.—"Mathematical Contributions to the Theory of Evolution. XI.—On the Influence of Natural Selection on the Variability and Correlation of Organs." By Karl Pearson, F.R.S.

The influence of directed—natural or artificial—selection on the characters of a race is one which it is fundamental for the purposes of evolution to appreciate quantitatively. I have already shown in an earlier memoir of this series the effect of random selection, or what it is better to term random sampling, on the characters of a population. Isolation of a few individuals who form a random sample may produce very sensible modifications of race characters, but it is to directed selection that we must look for changes on the largest scale. The subject is a very broad and complex one—no less than the total effect upon a population containing individuals at all ages of a selective death-rate applied for a long period and a function not only of the organs of each individual, but of the relationship of these organs to each other, and of the stage of growth of the individual. In the present memoir, attention is confined to the influence of selection in altering a complex of organs, no reproduction taking place during the selection.

A very definite distinction is at once reached, namely, that between directly and indirectly selected organs. It may be said that, although it is possible for the recruiting sergeant to select stature, and in so doing differentiate the arm-length of his troop from that of the general population, yet that in natural selection we are given only the modified organs, and so we cannot tell which of them have been directly and which indirectly selected. Both are changed; how discover which was the source of the change? The answer is: In the same manner as we could distinguish between two recruiting sergeants, one of whom selected his troop from the general population by stature, and the other by cubit; in either case the stature and cubit would be both modified, but the mathematical theory of regression would enable us to distinguish between the methods of operating of the two men, and even between them and one who selected by *both* stature and cubit at once. The mathematical theory as developed in this paper shows us that, although the whole complex of characters may have been changed, still, if direct selection has only occurred in p out of n possible cases, there will be certain of the partial regression coefficients which remain unmodified and which will theoretically enable us to distinguish among the whole group of differentiated organs, between those directly selected and those modified only because they happen to be correlated with the directly selected organs. Thus the distinction becomes one of singular importance, for though the selection of a few organs modifies the means, variabilities and correlations possibly of the whole complex of characters, certain functions of those quantities remain constant, and such constants ought to be discoverable, at any rate in theory, and should serve as the criterion of a common origin, when we deal with local races as having been subjected only to a selection *directly* differentiating a comparatively few characters.

If selection has changed a race from a condition A to a condition B, it becomes of much interest to determine the nature of the selective death-rate by which the process has been carried on, and it is found that this death-rate as represented in the surface of survival rates enables us to distinguish two kinds of selection, termed in the memoir positive and negative selection. In the first case, a race is modified, because the nearer its members are to having their organs with a certain system of values, the better fitted they are to survive; in the second case, the nearer the individuals are to this system the less fitted they are to survive. There will usually be in this second case, not a single system, but an indefinite number of systems which would equally well fit individuals to survive; in the first case, on the other hand, there are an indefinite number of systems which equally unfit their owners for surviving. This distinction seems of considerable interest.

For example, to select from the French race a race in femur and humerus like the Aino, we should have to proceed by a positive selection; but to select from the Aino a race like the French, we should have to proceed by a negative selection. To get 1000 Aino we should have to select for these two organs alone out of some 6,000,000 Frenchmen, but to get 1000 Frenchmen from the Aino we must select from about a billion of the latter. Thus we are to some extent able to appreciate the stringency of the selection, which even lasting through long ages, and introducing continuous reproduction, would be needful to enable us to pass in the case of only two organs from one race to the other. Another point brought out by the surface of survival-rates is the fact that the fittest to survive are usually not the most frequent survivors.

It will be seen that the memoir opens up a novel field of investigation, but one so wide that the theory of it must be limited by close contact with what is needful for the purposes of evolution. We want measurements on the local races of animals to guide us; at present we know scarcely in any one case whether differentiation has taken place by *direct* selection of few or of many organs. When once such measurements are forthcoming we shall have firmer ground to go upon, and the processes of the present memoir seem to suggest how in the future we shall be able to link together quantitatively local races, and possibly at a more remote date obtain quantitative conceptions of the stages of evolutionary descent itself.

January 30.—"The Specific Volumes of Oxygen and Nitrogen Vapour at the Boiling-point of Oxygen." By James Dewar, M.A., D.Sc., LL.D., F.R.S.

In a paper on "The Boiling-point of Liquid Hydrogen determined by Hydrogen and Helium Gas Thermometers" the author pointed out that a constant-volume gas-thermometer filled with oxygen gas, having a pressure at 0° C. of about 800 mm., gave a very accurate value of the boiling-point of liquid oxygen. As it seemed advisable to confirm this result indirectly, an attempt was made to determine the vapour density of oxygen at its boiling-point by direct weighing, the intention being, if the experimental results proved at all encouraging, to repeat the work on a larger scale and with greater precautions. As at present there is no likelihood of the more accurate determinations being made, the results of the preliminary inquiry are presented to the Society. They give in any case, with considerable accuracy, the specific volumes which have never been directly determined.

In order to obviate any question of the buoyancy of the air, two flasks A and B of as nearly as possible the same air displacement were counterpoised on an Œrtling balance. The B flask remained permanently on one scale of the balance during all the weighings, while the A flask was weighed, either exhausted or filled with oxygen (or nitrogen), in various circumstances according as the experiments required.

As the intention was not only to ascertain the density of oxygen and nitrogen at their respective boiling-points under atmospheric pressure, but also under diminished pressure, experiments were made with nitrogen at ordinary temperatures and at pressures varying from about one-sixth of an atmosphere to ordinary pressures, in order to find the range of variation in the results with the 316 c.c. flask to be used in the subsequent low-temperature experiments.

Experiments with nitrogen give a mean value of 1·260 grammes, at standard temperature and pressure, as the weight of a litre of the gas. This is about a quarter per cent. higher than the accepted value of 1·257. The extreme variation in the individual experiments is about half a per cent. The average value of the results under about one-third of an atmosphere is 1·266 grammes, the tendency under the low pressures being to make the density half a per cent. higher. Considering that in the actual low-temperature experiments the mass of gas to be weighed would be at least three times greater, it was inferred that in spite of difficulties of manipulation and corrections, the results might be anticipated to lie within a half per cent. of the true value.

The mean weight, given by six experiments, of one litre of oxygen vapour at 760 mm. and 90°·5 absolute was found to be 4·420 grammes, and the specific volume 226·25 c.c. If the first two experiments are eliminated on the assumption that the proper equilibrium of temperature had not been attained, the average weight per litre would become 4·428 grammes, and the specific volume 225·82.

Taking Regnault's density of oxygen at 0° and 760 mm., the density at 90°·5 in the ordinary way would be 0·0043137, and the specific volume 231·82 c.c. Thus the volume given by the ordinary gaseous laws is 1·0246 times the average observed volume; or we may put it that pv is diminished at the boiling-point of oxygen by 2·46 per cent. Again, while the ratio of the absolute temperatures is 3·017, the ratio of the densities is 3·091.

Further experiments were made on oxygen vapour at 90°·5 and under reduced pressures. If the first three experiments are averaged (the pressures being close together), the weight of a litre of oxygen at 90°·5 absolute under a pressure of 282·5 mm. would be 1·5982 grammes. The ratio of this density to the value previously found for one atmosphere pressure, viz. 4·42 grammes, is 2·765, and the ratio of the pressures is 2·690. It appears that the ratio of the change of density of the vapour of oxygen at 90°·5 absolute, under variable pressure, is greater than the ratio of the change of pressure. It is clear, however, that it would be necessary to work upon a larger scale in order to get satisfactory vapour densities at low temperatures under pressures below that of the atmosphere.

Observations were made on the density of nitrogen vapour at the boiling-points of liquid oxygen and liquid air respectively.

Two experiments were made with liquid oxygen taken to be at temperature 90°·5 absolute. Four experiments were made in one and the same sample of liquid air, with rising temperature. The first two experiments made with liquid oxygen give a ratio of the nitrogen densities from the author's own values of 3·088, the absolute temperature ratio being 3·017, his values for the ratio of the oxygen densities for the same range of temperature being 3·091 as previously deduced. It may be safely assumed that if the density of nitrogen were observed at its boiling-point it would deviate as much from the ordinary gaseous laws as oxygen. Further, the specific volume of nitrogen at its boiling-point of 78° absolute would from the above formula be 221·3 as compared with 226·2, the similar value found for oxygen.

The general inference to be drawn from these preliminary experiments is that trustworthy vapour densities may be determined at very low temperatures. There seems to be no reason why the vapour density of hydrogen at its boiling-point should not be accurately ascertained; only, as in this case the internal pressure in the weighing flask would amount to nearly fifteen atmospheres, it would be advisable to construct the flask of some metal or alloy. A flask of the size used in the oxygen experiments filled with the vapour of hydrogen at its boiling-point would be equivalent in weight to between four and five litres of hydrogen at the ordinary temperature and pressure, and such an amount of material ought to give density results at the boiling-point of hydrogen of considerable exactness, notwithstanding the great manipulative difficulties that would necessarily be involved in the execution of such a determination at 21° absolute.

Physical Society, February 14.—Annual General Meeting.—Mr. T. H. Blakesley, vice-president, in the chair.—Prof. S. P. Thompson, F.R.S., was re-elected president. Prof. S. P. Langley and Prof. H. A. Lorentz were elected honorary fellows to fill the vacancies caused by the deaths of Prof. Rowland and Dr. Koenig. The president of the German Physical Society was elected an *ex-officio* fellow of the Society.—The secretary then read the president's address. It commenced by giving some particulars of the life and work of Rowland, Koenig, Langley and Lorentz. On January 11 a telegram was sent, in the name of the Society, to Prof. Hittorf congratulating him upon the jubilee of the professoriate. The work of translation, revision and production of an English version of Gilbert's "De Magnete" has been completed, and a copy of the book presented to the Society by the president. The remainder of the address dealt with the refusal of the law of this country to recognise as valid matter for the granting of letters patent anything which may have been brought before any of the learned or scientific societies. In the United States a man may appeal to the fact of his having read such a paper in proof of his subsequent claim to receive a valid patent for his nvention. The law in this country works very inequitably. As examples, the invention of the microphone by the late Prof. Hughes, the president's invention of the "astigometer" and the invention of wireless telegraphy by Prof. Lodge were given. —An ordinary meeting of the Society was then held, at which Mr. Littlewood exhibited an Attwood's machine.—The Society then adjourned until February 28.

Chemical Society, February 6.—Dr. Armstrong, F.R.S., in the chair.—An investigation into the composition of brittle platinum, by Prof. Hartley, F.R.S. Platinum points repeatedly heated in the course of dental practice become very brittle, owing, the author believes, to the presence of minute quantities of carbon and phosphorus, although such impurities could not be definitely detected.—Conversion of 1-hydroxycamphene into β-halogen derivatives of camphor, by Dr. M. O. Forster. The author finds that his supposed "enolic" form of camphor is really 1-hydroxycamphene, and has studied the action of halogens upon it, so obtaining the various β-substituted camphors.—Tetrazoline, ii., by Messrs. Ruhemann and Stapleton. The action of methyl iodide upon this substance gives rise to several derivatives of unknown relation to tetrazoline.—The solubilities of the calcium salts of the lower fatty acids, by Dr. Lumsden. The author has investigated the influence of temperature upon the solubilities of these salts, and has shown that, with the exception of the formate, they decrease in solubility with increase of temperature. The salts of the normal acids show increasing solubility as the series is ascended, but are less soluble than the corresponding *iso*-salts.—The equilibrium between a solid and its saturated solution at various temperatures, by Dr. Lumsden. The solubility of a substance is affected by three factors—the solution pressure of the dissolved molecules, the thermal energy of dissociation of the substance, and the affinity, if any, of solvent and solute. The solubility curve (temperature, weight of substance) may be regarded as expressing a series of equilibria between these influences at the various temperatures included in the curve, and from this point of view it is shown that the solubility curves of calcium salts are not abnormal.—On the union of hydrogen and chlorine, iv., by Messrs. Mellor and Anderson. The momentary expansion in mixtures of these gases, brought about by exposure to a brilliant light, is shown to be associated with their combination and, it is suggested, is caused by some disturbance resulting from the latter.—The influence of temperature on association in benzene solution and the value of the molecular rise of boiling-point for benzene at different temperatures, by Dr. W. R. Innes. With increase of temperature, the complex molecules of phenanthrene, benzophenone, benzil, &c., produced in their solutions in benzene, become simpler up to 80°; beyond that point certain (at present) unexplained anomalies appear.—The magnetic rotation of ring compounds, camphor, limonene, carvene, pinene and some of their derivatives, by Dr. W. H. Perkin, sen. It is shown that the observed rotations of these substances agree closely with those calculated from the formulæ generally assigned to them.—Note on the constitution of certain organic nitrates, by Messrs. Marshall and Wigner. The authors express dissent from the view of Vignon and Gerin that mannitol hexanitrate contains a substituted aldehyde group, since the reducing action of the substance can be explained without such an assumption, and, moreover, the amount of nitrous acid formed on hydrolysis does not accord with the structure suggested.—Resolution of trimethylhydrindonium hydroxide into its optically active constituents, by Prof. F. S. Kipping, F.R.S. The deracemisation of this substance has been brought about by conversion into a salt of *d*-bromocamphorsulphonic acid and crystallisation from chloroform and acetic ether when the salt of the dextro-base separates first.—Resolution of methylbenzylacetic acid into its optical isomerides, by Prof. F. S. Kipping, F.R.S. Crystallisation of the quinine salt of the racemic form of this acid leads to the separation of the alkaloidal salt of the dextro-acid in the first fractions.—*d*-Methylhydrindone, by Prof. F. S. Kipping, F.R.S. This substance was obtained from the chloride of dimethylbenzylacetic acid by interaction with aluminium chloride. It rapidly racemises when heated, probably as the result of conversion into the 'enolic' form. It reacts with hydroxylamine, phenylhydrazone and semicarbazide, furnishing the various ketonic derivatives.—Optically active methylbenzylacetic acid, by Dr. Lapworth and Mr. Lenton. A repetition of the work described by Dr. Kipping in part ii.

Mineralogical Society, February 4.—Dr. Hugo Müller, president, in the chair.—Messrs. G. T. Prior and L. J. Spencer contributed a paper on the hornsilvers. They described specimens of silver haloid containing all the three halogens, chlorine, bromine and iodine, in large amount, and showed by quantitative analyses that in these holohedral cubic "iodiferous embolites" the chloride, bromide and iodide of silver could enter into isomorphous combination in very varying proportions besides the particular one found by Lasaulx in iodobromite; fusion experiments indicated that the limiting amount of silver iodide which could enter into such isomorphous combination was reached for mixtures containing the three halogens in equal atomic proportions. As the result of the investigation, the authors proposed to include all the holohedral cubic silver haloids under the common group name of hornsilver or cerargyrite, and to use the names "chlorargyrite," "bromargyrite," "embolite" and "iodiferous embolite" to indicate subspecies depending on variations in the proportions of chloride, bromide and iodide.—Mr. G. T. Prior described specimens of kilbrickenite contained in the museum of the Mining School at Camborne, Cornwall; the result of an analysis, combined with an examination of the physical characters, was to prove the identity of kilbrickenite with geocronite. He also gave the results of analyses of miersite (4AgI.CuI), of marshite (CuI) and of peculiar crystals of copper-pyrites simulating cubic symmetry.—Messrs. G. T. Prior and A. K. Coomára-Swámy gave an account of the mode of occurrence and characters of "serendibite," a new boro-silicate from Ceylon. This new mineral, which is of a beautiful blue colour, was discovered by Mr. Coomára-Swámy in intimate association with diopside in narrow contact zones between an acid, moonstone-bearing granulite and limestone which occur in alternating bands at Gangapiliya, twelve miles east of Kandy; no distinct crystals could be isolated, but examination of thin slices of the rock showed the mineral to be biaxial and probably triclinic; it was very pleochroic, from colourless to deep indigo-blue, and almost invariably showed a remarkable repeated twinning on as intimate a scale as the albite twinning of a plagioclastic felspar; the double-refraction is weak, but the refraction nearly as high as diopside; the hardness is about 7, the specific gravity 3·42; no cleavage was observed; it is infusible and is only slightly attacked by acids. Analysis showed the mineral to be a complex and very basic borosilicate of alumina, lime, magnesia and iron with small amounts of alkalis including lithia.—Prof. H. A. Miers exhibited three-colour collotype prints of the interference figures of crystals. These were obtained by photographing the figures through colour screens by means of a large Newton polariscope. Some of the prints reproduced with considerable success the colours and the symmetry of the original figures. The work has been executed at the Oxford University Press. He further exhibited calcite twins of a rare type from a new locality in Somersetshire, and also some crystalline gold nuggets from Klondyke.

PARIS.

Academy of Sciences, February 10.—M. Bouquet de la Grye in the chair.—On a very powerful specific treatment for malaria, by M. Armand Gautier. A detailed account of the cure of nine cases of malarial fever by the injection of sodium methylarsenate. These cases, which had all proved refractory to high doses of quinine, were, with the exception of two, immediately cured by the injection of a single dose of the methylarsenate. The remaining two cases were successfully treated with a second injection.—On the crystallisation of chromium sesquioxide, by M. Alfred Ditte. The crystallisation of chromium oxide during the calcination of a bichromate with common salt is shown to be due to the properties of sodium chlorochromate, and is in no way influenced by the solubility of the oxide in the alkaline chloride.—The determination of the exact trajectory of aërostats with respect to the soil, by M. H. Deslandres. A curve of the trajectory of the aërostat of M. Dumont on the ascent of October 19 is given and compared with the curve previously given by M. Armengaud. The two curves differ from each other considerably, the author pointing out that his own, which is deduced by a photographic method, is more likely to be accurate than that of M. Armengaud.—Radioconductors with a single contact, by M. Édouard Branly. The author has followed up some of his earlier experiments on radioconductors of one contact only, and describes two or three types which have proved very sensitive. The combination of a superficially oxidised metal with a highly polished metal has proved to be the most trustworthy, giving the greatest variation of resistance when exposed to the Hertzian waves.—The application of thermal galvanometers to the study of electric waves, by M. L. de Broglie.—The tubes of force of the magnetic field rendered visible by means of the kathode rays, by M. H. Pellat. In an intense magnetic field, the bundle of kathode rays which escapes from a kathode in the form of a plateau corresponds exactly to the tube of magnetic force having for its base the surface of the kathode.—On the condensation of true acetylenic hydrocarbons with aldehydes: the synthesis of secondary acetylene alcohols, by MM. Ch. Moureu and H. Desmots. The sodium derivatives of the acetylene hydrocarbon react readily with aldehydes in ethereal solution at -5° C. The method is perfectly general, and ten new alcohols of this type are described.—On some iodophenols, by M. P. Brenans.—The action of crystallised arsenic acid upon pinene, by M. P. Genvresse. Arsenic acid does not act as an oxidising agent towards pinene as was expected, the principal products being either pinene possessing a different smell from the original or a terpinene, according to the proportion of arsenic acid employed.—The vascularisation of the suprarenal bodies in the dogfish, by M. Ed. Grynfeltt.—On *Menabea venenata* the roots of which furnish the *Tanghin de Menabe*, or *Sakalaves*, the poison of the ordeal, also called *Kissoumpa* or *Kimanga* in Madagascar, by M. Ed. Heckel.—On the effects of commensalism of an *Amylomyces* and of a *Micrococcus*, by M. Paul Vuillemin. The association of *Mucor rouxianus* and a *Micrococcus* feeding on sugar allows of the development of the bacterium on potato.—The discovery of a new horizon of a lacustral fossiliferous limestone interposed between the Miocenes of Ariege, by M. G. Vasseur.—On the alkaline granite of Filfila, Algiers, by M. Pierre Termier.—A new method of local anæsthesia in dentistry, by MM. L. R. Regnier and Henry Didsbury. The researches of M. d'Arsonval on the anæsthetic effects produced by currents of high frequency and high intensity have been applied with success to the purposes of practical dentistry.—An apparatus for the blind, by M. Dussaud.

GÖTTINGEN.

Royal Society of Sciences.—The *Nachrichten* (physico-mathematical section), part ii., 1902, contains the following memoirs communicated to the Society:—

July 20, 1901.—A. von Koenen: on the correlation of the North-German Lower Chalk.—J. Orth: contributions from the Göttingen Pathological Institute: (*a*) ætiology of caseous pneumonia; (*b*) tubal gravidity; (*c*) the lower jaw in so-called agnathia; (*d*) pseudo-tuberculosis; (*e*) soft cutaneous nævi; (*f*) epidermal ingrowths in cancer; (*g*) pericardial cicatrices; (*h*) renal degeneration after cœliotomy; (*i*) the testicular elastic tissue in tuberculosis and syphilis; (*j*) angiomatous changes in the liver after poisoning by coumarin.—J. Orth: histology and ætiology of pulmonary phthisis.

November 8, 1901.—W. Kaufmann: electric and magnetic deflexion of the Becquerel rays, and the apparent mass of electrons.—A. Brill: on the representation of an algebraic tortuous curve by one equation.

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 20.

ROYAL SOCIETY, at 4.30.—On Pure Cultures of a Uredine *Puccinia dispersa* (Erikss): Prof. H. M. Ward, F.R.S.—On the Physics and Physiology of Protoplasmic Streaming in Plants: Dr. A. J. Ewart.—On a Pair of Ciliated Grooves in the Brain of the Ammocœte, apparently serving to promote the Circulation of the Fluid in the Brain-Cavity: Prof. A. Dendy.—On the Interpretation of Photographic Records of the Response of Nerve obtained with the Capillary Electrometer: G. J. Burch, F.R.S.—Note on the Anomalous Dispersion of Sodium Vapour: Prof. W. H. Julius.

LINNEAN SOCIETY, at 8.—(1) On some Gasteropoda (*Limnotrochus* and *Chitra*) from Lake Tanganyika, with the Description of a New Genus; (2) On the Nyassa Vivipara and its Relationship to Neothauma: Miss L. Digby.—On the Fruit of *Melocarina bambusoides*, an Exalbuminous Grass: Dr. A. Stapf.—On a West Indian Sea Anemone, *Bunodeopsis globulifera*: Dr. J. E. Duerden.

FRIDAY, FEBRUARY 21.

ROYAL INSTITUTION, at 9.—Musical and Talking Electric Arcs: W. Duddell.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Annual General Meeting. Followed by discussion on Modern Machine Methods, with Reply by the Author, H. L. F. Orcutt, and, time permitting, Fencing of Steam- and Gas-Engines: H. D. Marshall.—Fencing or Guarding Machinery used in Textile Factories: S. R. Platt.—Protection of Lift-Shafts, and Safety Devices in connection with Lift-Doors and Controlling Gear: H. C. Walker.—Guarding Machine Tools: W. H. Johnson.

GEOLOGICAL SOCIETY, at 3.—Annual General Meeting.

EPIDEMIOLOGICAL SOCIETY, at 8.30.

SATURDAY, FEBRUARY 22.

ROYAL INSTITUTION, at 3.—Some Electrical Developments: Lord Rayleigh, F.R.S.

ESSEX FIELD CLUB (at Essex Museum of Natural History, Stratford), at 6.30.—George Edwards, the Stratford Naturalist: John Avery.—Protective Resemblance, Warning Colours and Mimicry, some New Illustrations of well-known Principles: Prof. E. B. Poulton, F.R.S.

MONDAY, FEBRUARY 24.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The Voyage of the Antarctic Ship *Discovery*: The President; G. Murray, F.R.S.; and Dr. H. R. Mill.

SOCIETY OF ARTS, at 8.—Personal Jewellery from Prehistoric Times: Cyril Davenport.

IMPERIAL INSTITUTE, at 8.30.—British Columbia: Hon. J. H. Turner.

INSTITUTE OF ACTUARIES, at 5.30.—Some Notes on the Net Premium Method of Valuation, as affected by recent Tendencies and Developments: S. G. Warner.

TUESDAY, FEBRUARY 25.

ROYAL INSTITUTION, at 3.—The Temperature of the Atmosphere: W. N. Shaw, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Paper to be further discussed*: Electrical Traction on Railways: W. M. Mordey and B. M. Jenkin.

SOCIETY FOR THE PROMOTION OF HELLENIC STUDIES, at 5.—Humour in Greek Art: A. H. Smith.

WEDNESDAY, FEBRUARY 26.

SOCIETY OF ARTS, at 8.—Recent Inventions in Weaving Machinery: Prof. Roberts Beaumont.

GEOLOGICAL SOCIETY, at 8.—On some Gaps in the Lias: E. A. Walford.—The Origin of the River-System of South Wales and its Connection with that of the Severn and Thames: A. Strahan.

THURSDAY, FEBRUARY 27.

ROYAL SOCIETY, at 4.30.

SOCIETY OF ARTS at 4.30.—The Industrial Development of India Nilkanth B. Wagle.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Electric Shock and Legislation thereon: Major-General C. E. Webber, C.B., R.E.—Electric Shocks: F. B. Aspinall.—Electric Shocks at 500 volts (illustrated by a Demonstration of 500 volts): A. P. Trotter.

FRIDAY, FEBRUARY 28.

ROYAL INSTITUTION, at 9.—Gold Mining in Klondyke: Prof. H. A. Miers, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Indicating High-Speed Steam-Engines: A. M. Arter.

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