THURSDAY, MARCH 27, 1913.

FOREST PHYSIOGRAPHY.

Physiography of the United States and Principles of Soils in Relation to Forestry. By Prof. I. Bowman. Pp. xxii+759. (New York: J. Wiley and Sons; London: Chapman and Hall, Ltd., 1911.) Price 21*s.* net.

AS the longer title of this work denotes, this is not a book on forestry, but on physiography for students of forestry, and especially for those of the United States. The book is in two parts, the first of which forms a complete treatise on the subject of soils, and it is this part which will be of most interest to foresters and nature-students in this country. The second and larger part is devoted to a description of the United States, according to physiographic regions, in regard to geology, climate, soil, and vegetation.

In reading this book one cannot fail to be impressed by the prominence given to the question of water and water-supply. "Water constitutes from 65 per cent. to more than 95 per cent. of the tissues of plants," and "is the factor that most frequently conditions life and death." Water is also the natural force which is most capable of being controlled by man: by the preservation of soil-cover and by a proper system of drainage promoting its beneficial influences and checking its dangers. In this connection Fernow is quoted as saying:

"The leaf canopy catches and re-evaporates about 12 per cent. of the rainfall, while 10 per cent. of it runs along the tree-trunks and reaches the ground by a circuitous course. The forest litter, the moss-covered and leaf-strewn ground, is capable of absorbing water at the rate of 40,000,000 to 50,000,000 cubic feet per square mile in ten minutes—water whose progress is delayed by some twelve to fifteen hours after the first effects of a heavy freshet have passed."

The author deplores the reckless timber-cutting which has taken place in America during the last twenty-five years, with the result that the soil, "the inheritance of geologic ages," has in many cases been washed away or impoverished. In a striking paragraph, in dealing with the evil effects of deforestation in the southern Appalachians, he writes:

"The rain beats directly upon the soil, the retarding influence of the ground litter and tree-roots is withdrawn, and more rapid soil removal occurs. When once these evil effects have been allowed to take place, mankind is deprived practically for thousands and even millions of years of the favourable conditions that preceded the epoch of destruction. In a hundred years man may achieve such baneful results as nature will compensate only during a geologic period of hundreds of thousands of years. Soil is a resource of priceless value. On resistant rocks its formation is excessively slow. Many glacial striæ formed on resistant rock during the last glacial epoch, roughly 60,000 to 75,000 years ago, are still preserved as fresh as if they were made but yesterday. In that time man has come up from the cave and the stone-hammer. Seventy thousand years is a very short time for the development of a soil-cover; for man it means a period so great that his mind can hardly appreciate it. The earth as we find it in the geologic to-day must be treated with care if the human race is to have a fair distribution of its wealth in time. To the geologic mind there is something shocking in the thought that a single lumber merchant may in fifty years deprive the human race of soil that required 10,000 years to form."

Although forests undoubtedly tend to regulate stream-flow, the author is careful to show that they are not an absolute preventive of flooding, and that in individual cases their influence may be quite insignificant. It is largely a matter of soil and situation, but where soil removal exceeds soil formation, or where the balance between the two is only delicately established, the destruction of forests can only be attended by disastrous consequences.

The chemistry of the soil, the effects of sun, air, wind, the beneficial influences of the lower forms of vegetable and animal life, are each dealt with in a concise though comprehensive manner, and frequent footnotes give authorities for statements made and references to further literature on the various points discussed.

A key-list giving the scientific names of the trees referred to by their common names would be of value, and there are a few minor errors which should be corrected in future editions.

The book is admirably produced, and fully illustrated by diagrams, maps, and photographs, and forms a most useful addition to the literature of the subject.

J. W. MACKAY.

THE HIGHWAY OF ANIMAL EVOLUTION.

The Evolution of the Vertebrates and their Kin. By Dr. William Patten. Pp. xxi+486; illustrated. (London: J. and A. Churchill, 1912.) Price 21*s.* net.

THE author presents in a stately form a detailed account of his theory of the Arachnid origin of vertebrates. He has worked at this persistently since 1884, and in the course of his investigations has made important contributions to our knowledge of Limulus and the Ostracoderms. No one will withhold admiration who looks into the details of comparative anatomy, histology, and embryology with which

this large and finely illustrated volume is filled, for Prof. Patten has spared no labour in his endeavour to test what seems to him to be an approximate solution of the problem of the evolution of the vertebrates. It may be said at the outset that his theory is quite different from Gaskell's, which, in his judgment, was vitiated by the assumption that the neural surface of an Arthropod is the same as the hæmal surface of a vertebrate.

The general thesis is that "the great Vertebrate-Ostracoderm-Arthropod phylum forms the main trunk of the genealogical tree." Vertebrates arose through Ostracoderms from Arachnid-like Arthropods. One of the important steps was cephalogenesis, numerous anterior metameres being integrated into a "head"—prophetic of the vertebrate head; the old mouth was closed and a new one opened; the bases of the more anterior appendages were forced towards the hæmal surface to form the vertebrate oral arches; the heart was drawn forwards; true gill-clefts appeared; the lateral eye placodes were transferred to the interior of the cerebral vesicle and the optic ganglia to the roof of the mid-brain; and so on.

The Arachnids' forebrain vesicle is formed like that of vertebrates; both have the same sort of pineal eye; Arachnids have a cartilaginous endocranium similar in shape and location to the primordial cranium of vertebrates, and they have an axial subneural rod comparable with the notochord; in Arachnids the brain contains approximately the same number of neuromeres as in vertebrates—these are fair illustrations of the arguments by which Prof. Patten supports his thesis. With his guiding idea of an Arachnid-Ostracoderm-Vertebrate alliance, Prof. Patten feels that the numerous resemblances he adduces have a cumulative convincingness. We must confess that many of them appear to us exceedingly far-fetched, *e.g.* that the "lemmatochord" is comparable to the notochord, and that many others, *e.g.* "endocranium" and cranium, simply illustrate convergence. To the preliminary objection that Arachnids are far too specialised to have given rise to vertebrates, the author gives an answer the point of which we cannot profess to see, that "every animal is a specialised one when compared with its ancestors, and at the same time a generalised one when compared with its descendants."

In regard to the position of other classes involved, Prof. Patten holds remarkable views. The Ostracoderms are intermediate between Arachnids and vertebrates; the Cirripedes are the only members of the Acraniates in which the more typical Arthropod characters are retained; the Tunicates are descended from that particular subdivision of the Arthropods to which the Cirripedes and Copepods belongs; the Echinoderms are also descended from Cirriped-like Arthropods, as may be inferred from the nauplius-like larval form; the Enteropneusta are probably descendants of primitive Arthropods; the Pterobranchs have in certain respects, such as the six pairs of appendages, a decidedly arachnoid character; the Polyzoa may best be interpreted as descendants of primitive Arthropods of the Cirriped type; the Chætognatha are unquestionably primitive Arthropods, somewhat degenerate. Thus we see how the clearing up of the main highway—the Arachnid-Ostracoderm-Vertebrate line—makes the relations of the byways plain! There is much to be said for vigorous heresy, but this is a perversion of morphology. We are minded, however, of the saying of another investigator of the pedigree of vertebrates, that "in morphology everything is important except the hypothesis." In conclusion, we may note that Prof. Patten's researches have made him a convinced "bathmist." The internal processes of differential growth and readjustment are fundamentally important. Environmental influence, natural selection, and the like have played an insignificant subordinate part. "The creative power of internal environment is always present, always active, always changing." We confess to liking this view better than the author's phylogeny.

ZOOLOGY AND NATURAL HISTORY.

(1) *Animal Secrets Told: A Book of "Whys."* By H. C. Brearley. With twelve full-page illustrations from photographs by Elwin R. Sanborn. Pp. xvi+274. (London: Headley Brothers, n.d.) Price 5*s.* net.

(2) *Wild Life in the West Highlands.* By C. H. Alston. With illustrations by A. Scott Rankin. Pp. xi+271. (Glasgow: James MacLehose and Sons, 1912.) Price 6*s.* net.

(3) *The Sheep and Its Cousins.* By R. Lydekker, F.R.S. Pp. xv+315. (London: George Allen and Co., Ltd., 1912.) Price 10*s.* 6*d.* net.

(4) *The Marine Mammals in the Anatomical Museum of the University of Edinburgh.* Part i., Cetacea; Part ii., Sirenia; Part iii., Pinnipedia. By Sir Wm. Turner, K.C.B. Pp. xv+207. (London: Macmillan and Co., Ltd., 1912.) Price 6*s.* net.

(5) *The Growth of Groups in the Animal Kingdom.* By Prof. R. E. Lloyd. Pp. viii+185. (London: Longmans, Green and Co., 1912.) Price 5*s.* net.

"ANIMAL Secrets Told" (1) is a series of popular articles explaining, or attempting to explain, the reason for special variation in the

shape and structure of some of the external organs, like the feet, tail, ears, and noses, of certain selected types of vertebrate animals. The book contains much that is instructive and true and suggestive; but some of it is highly imaginative and must not be taken too seriously by the uninformed.

There is not much that is new in Mr. Alston's pleasant little volume (2). It is a collection of essays on a variety of topics ranging from the former existence of the wolf and beaver in Scotland to the value of different colours in the making of anglers' flies. The author is a keen field naturalist, and his ardent advocacy of the protection of indigenous British species of birds and mammals finds expression in the chapters devoted to the sea-eagle, the wild-cat, and members of the weasel tribe. The book concludes with two chapters quite unsuggested by the title. One is upon elephants in Ceylon and the other upon the sheep-killing Kea parrot of New Zealand. In this there is a never previously published account of this bird, supplied to Mr. Alston by Mr. Alexander F. Brown, one of the survivors of the enterprising pioneers of the higher ranges of the South Island.

"The Sheep and Its Cousins" (3) is the outcome of work Mr. Lydekker has been doing for some years in carrying out Sir Ray Lankester's wise scheme for preserving permanent records of breeds of domesticated animals by exhibiting mounted specimens in a special gallery in the Natural History Museum. Mr. Lydekker has made good use of the opportunities afforded by his official position in that institution to get together examples of many rare forms of sheep, about which most zoologists had previously nothing beyond bibliographical knowledge. An account of these, together with descriptions of the principal European breeds and summaries of the highly speculative views of authors touching their origins and affinities, about which practically nothing is known, forms the greater part of this volume, which will form a useful guide for a more thorough and scientific treatise on the subject.

In connection with the oft discussed, but quite unsettled, question of the origin of tame sheep, one cannot suppress a feeling of envy at the assurance with which their differences from wild species are lightly dismissed as due to domestication; and one wonders if Mr. Lydekker realises that his adoption, or seeming adoption, of the view that they are descended from two or more distinct species involves the conclusion that their common characters must have been independently developed at least twice. It may be so; but the evidence for this amounts at present to very little. About the treatment of the wild species, one is at a loss what to say, except that if the author really knows them, apart from their geographical distribution, he has been very unjust to himself. Presumably, the scientifically indefensible inclusion of the Audad (Ammotragus) and the Bharal (Pseudoïs) in a volume devoted to sheep (Ovis), from which goats (Capra) are excluded, is a concession to popular terminology; but since Mr. Lydekker calls them "aberrant sheep" one suspects that he scarcely appreciates rightly the distinguishing characters of these four genera. Naturally, the book is not free from mistakes. For instance, it is stated that the female Bharal lacks at all ages the dark markings of the male. Probably this is never true. Certainly it is not always true. This and other errors, however, will no doubt be corrected in future editions.

(4) In compiling a catalogue of the skeletal and anatomical remains of the Cetacea, Sirenia, and Pinnipedia belonging to the University of Edinburgh, Sir William Turner has taken the opportunity of putting into the hands of zoologists an invaluable monograph containing brief definitions of the families, genera, and often of the species of these three orders, as well as descriptions of the chief osteological, dental, anatomical, and fœtal preparations in the rich collection at his disposal. A surprising amount of information is packed into the two hundred odd pages of the volume, and when one adds that it is illustrated with seventeen plates and more than one hundred text figures, no further evidence need be adduced of its usefulness to students of these orders.

For the classification of the Cetacea, the author has paid special attention to the characters displayed by the fronto-naso-premaxillary region, the rostrum, the hard palate and pterygoids, the teeth and the tympano-periotic bones, and, in the introduction to this order, the principal modifications of these parts of the skull in different genera are briefly detailed. The rest of this introduction contains an account, equally interesting to naturalists and zoologists, of species of whales stranded on the coast of Scotland both in recent times and in the prehistoric period before the land and sea had assumed their present level.

The aim of Dr. Lloyd's book (5) is, as he tells us, to lessen the belief in natural selection as a creative agency, and its pages are devoted mainly to pointing out the variations in colour and other characters presented by the common black rat (*Mus rattus*) in India. Exceptional opportunities for this valuable piece of statistical research work were afforded by the campaign against these pests undertaken by the Plague Commission in 1907, examination of the material sent to Calcutta being part of Dr. Lloyd's work.

He shows amongst other things that variation in the colour of certain areas, especially of the ventral surface and of the tail, is discontinuous and that not infrequently several individuals differ from the ordinary run of rats in a particular district by a combination of characters similar to those used by systematists for discriminating species or subspecies of Muridæ. In the case of *Mus rattus* it is tolerably evident that these individuals are members of a family party; yet, as Dr. Lloyd insists, if a similar series of individuals were to emanate from a "field" species of Mus and were to fall into the hands of a systematist, they would probably be regarded as representatives of an undescribed form and be named accordingly; and in that case they might for ever remain the sole examples of the species or subspecies, so-called. On the other hand, such a series might by isolation in their locality give rise to a persistent type. Dr. Lloyd discusses the question of the origin of "species" from mutants, and expresses the opinion that species have arisen in that way, irrespective of natural selection; and it seems that he would lessen, to that extent at all events, the belief in natural selection as a creative—one would have preferred "guiding" or "fostering"—agency. He also supports his case by citing Tower's records and statistics touching the potato beetle. His views are clearly and modestly put forward, and his book is worth careful attention, although the omission of an index, of a table of contents, and even of headlines to the chapters makes the reading more difficult than it need have been. R. I. P.

METALLURGICAL INDUSTRIES.

(1) *A Text-book of Rand Metallurgical Practice.* Designed as a "Working Tool" and Practical Guide for Metallurgists upon the Witwatersrand and other Similar Fields. By Ralph Stokes, Jas. E. Thomas, G. O. Smart, W. R. Dowling, H. A. White, E. H. Johnson, W. A. Caldecott, A. McA. Johnston, and C. O. Schmitt. Vol. ii. Pp. xxii+438. (London: C. Griffin and Co., Ltd., 1912.) Price 21*s.* net.

(2) *The Technology of Iron Enamelling and Tinning.* Being Collected Papers. By J. Grünwald. Translated from the German by Dr. H. H. Hodgson. Pp. viii+139. (London: C. Griffin and Co., Ltd., 1912.) Price 6*s.* net.

(3) *Notes on Foundry Practice.* By J. J. Morgan. Pp. ix+108. (London: C. Griffin and Co., Ltd., 1912.) Price 2*s.* 6*d.* net.

(1) THE second volume of this work is by Mr. C. O. Schmitt, and consists of two sections—"The Design and Construction of Reduction Plant" and "The Transport of Material"—the latter naturally being the smaller, occupying the last hundred pages of the book.

The first section deals in a systematic manner with the reduction plant used on the Rand, taking in order the breaking plant, stamp mill, tube mill, sand plant, slime plant, and precipitation plant, and the author has covered this ground very thoroughly, giving much useful information; for instance, when considering the design of a reduction plant, the value of a volume diagram and a flow sheet, in addition to the plan and elevation of the plant, is pointed out. The chapter on "Sorting and Breaking Plant" is good, the subject being fully discussed, while under "Crushing Plant" there is a comprehensive description of the stamp mill found on the Rand, all various parts of the battery being considered.

The section on the modern foundations for mortar boxes is particularly instructive and is well illustrated. The "Nissen" stamp mill, which has recently been run experimentally at the City Deep, is briefly described. A most adequate account of the Rand cyanide plant is given, and it should be of use to all engaged in the cyaniding of gold ores, for the cyanide process has proved a most satisfactory means for the further treatment of the Rand ore, with the result that there have been great developments in the plant. An important chapter on "Estimating" is included, and the author of this volume rightly insists that a detailed estimate of the cost of a plant which has been designed is essential, and for this purpose gives a set of useful schedules.

In the second section of the book the plant for the transport of material is fully described, the methods of handling ore, dry sand, dry slime, pulp and sand residue being given. This section should be of general interest to mining and metallurgical engineers, for the lack of labour on the Rand has made mechanical handling of material a necessity; consequently a large number of appliances is considered.

The volume is copiously illustrated, and contains many useful tables and valuable diagrams as well as a good bibliography.

The work is, as the authors claim, a "practical book for practical men," and, although dealing with the metallurgical practice upon the Witwatersrand, will be of value to those engaged on goldfields where some of the conditions are similar. The advanced student who is studying the metallurgy of gold will find it a useful book, for it will broaden his outlook, give him an insight into industrial problems, and will put before him information gained by practical experience. The book can be thoroughly recommended.

(2) These papers form valuable contributions to the technology of iron enamelling, for particular problems or aspects of the industry are considered; but, so far as the technology of tinning is concerned, there are only three papers: one historical, another on the grey allotropic modification of tin, and the third giving short accounts of processes for the recovery of tin from tinned waste.

The papers which deal with the composition of various enamels and their mode of manufacture are the most important, and much information, gained by actual experience, is given. As very few works in the enamelling industry employ chemists, a paper showing how the chemical composition of an enamel may be determined by calculation has very wisely been included in the series. The paper with the title "The Examination of Cast-iron Enamels" has not been happily named. The translator is to be commended on the satisfactory manner in which he has carried out his work. Managers of enamel works and all those concerned with the problems of the enamelling industry will find much valuable information in these papers.

(3) This work deals chiefly with iron-founding, and gives a general description of the materials used, the methods adopted, and the appliances employed. The influences of the various elements usually present in cast-iron are discussed, and several analyses of pig-iron are given. The cupola and other foundry furnaces are briefly but clearly described, and an exceedingly good and concise description is given of moulding-sands and moulding. It would have been an advantage to have placed the sections on moulding-sand and openers later in the book, so as they would precede "Moulding." The book should prove very useful to technical students and to engineers who wish to gain a general idea of foundry practice.

OUR BOOKSHELF.

Die sanitarisch-pathologische Bedeutung der Insekten und verwandten Gliedertiere, namentlich als Krankheits-Erreger und Krankheits-Ueberträger. By Prof. Emil A. Göldi. Pp. 155. (Berlin: R. Friedländer und Sohn, 1913.) Price 9 marks.

HERE we have a clear and compendious account of the Arthropods concerned in the causation of disease, particularly of tropical diseases. It will, perhaps, be more useful in the class-room than in the laboratory, since, though the author is very sound in his appreciation of the entomological factor in pathological research, he treats his Arthropods by a sort of criminatory standard peculiarly profitable to the novice.

In the first section the Arthropods that bite and sting in their several ways are dealt with, the structure of the organ of offence and the nature and effects of the injury being described in every case. Here is included a multitude of figures of urticating caterpillars from South America. It will surprise those who know only the scorpions of the Old World to learn from the author that from 200 to 250 children are killed annually in Mexico alone by scorpions.

A second section is concerned with Arthropods as parasites of man. These are differentiated as occasional bloodsuckers so far as man is concerned, such as mosquitoes, gadflies, &c.; professional bloodsuckers, such as Stomoxeinæ, bedbugs, &c.; and thoroughgoing parasites, such as lice, fleas, bots, ticks, &c. The means and methods of offence and the effects of the parasitism are discussed; and the various kinds of parasites are described and figured, so as to make clear not only their general appearance, life-history, and metamorphoses, but also many necessary and contingent anatomical details.

The third section treats of Arthropods as carriers of specific pathogenic micro-organisms. Here the text is plentifully illustrated with figures of notorious micro-parasites in their various phases, of the infected tissues and organs of the specific Arthropod carrier, and of the disastrous effects upon the ultimate victims—men and domestic animals.

The book is written in a crisp and (if the adjective may be allowed in this connection) attractive style, and is well printed.

Grundzüge der allgemeinen Phytopathologie. By Dr. H. Klebahn. Pp. 147. (Berlin: Gebrüder Borntraeger, 1912.) Price 4.80 marks.

PROF. KLEBAHN'S high reputation as a research worker in mycology leads one to expect in a book from his pen exactly what one finds in this volume: an admirable combination of clearness and terseness, the essentials of the subject being presented in a striking manner and the details of minor importance lightly touched upon or omitted. It is safe to assert that never has such an accurate, interesting, and philosophical account of the various diseases which afflict cultivated plants been compressed into fewer than 150 pages, and that this is probably the best general introduction to the study of phytopathology that has yet been published.

The book is characterised by its scientific rather than technical treatment of the subject, the author laying stress upon the necessity for a thorough understanding of the symptoms and causes of plant disease as a preliminary to the application of therapeutic and prophylactic measures, and he has deliberately limited his scope to pure pathology. Before proceeding to consider the diseases induced by fungi, insects, and other organisms, he discusses chemical and physical conditions of the soil, climatic conditions, wounds, smoke, and chemical fumes as causes of disease in plants;

and the wide view which is taken of the subject is further reflected in the sections at the end of the book devoted to non-parasitic diseases (caused doubtless by disturbances in physiological balance generally and in enzyme secretion particularly) and to various abnormalities in growth.

F. C.

The Bradshaw Lecture on the Biology of Tumours. By C. Mansell Moullin. Pp. 39. (London: H. K. Lewis, 1913.) Price 2*s.* net.

MR. MANSELL MOULLIN has published as a booklet the Bradshaw lecture which he recently delivered before the Royal College of Surgeons. It treats of new growths or tumours from the biological point of view; he regards the division of them into malignant and innocent as a mere useful convention; there is no sharp line of demarcation between the two groups. He prefers a division into those which spring from germ-cells and possess a more or less complete individuality, and those which spring from somatic cells and are due to escape from control of what remains to them of their primitive form of growth. The short course of an hour's lecture precluded any full treatment of this large subject. The various theories of malignancy are not discussed, but the parasitic nature of cancer is denied. With regard to cure, we have the confession that at present the surgeon's knife is the only safe remedy, though the lecture concludes with the hope that this will not always be so. No reference is made to the part chemistry has played or will play in the elucidation of the cancer problem. Until we know what are the biochemical or metabolic actions in the cells of a new growth, we can scarcely hope to grapple with the methods which will ensure recovery.

W. D. H.

The Physical and Political School Atlas. By J. G. Bartholomew. Pp. xvi of uncoloured maps and texts; 32 coloured maps. (London: Oxford University Press, 1913.) Price 1*s.* net.

THIS cheap and trustworthy atlas may be commended to the attention of teachers of geography. The attempt in some cases to show land relief and other physical features as well as the political geography of a country on one and the same map has led to overcrowding and indistinctness. Where this mistake has been avoided the maps are bold, clear, and convincing.

"Half-inch to Mile" Map of England and Wales. Sheet 3. Cumberland, &c. New and revised edition. (Edinburgh: John Bartholomew and Co., n.d.) Price, in case: 1*s.* 6*d.* paper; 2*s.* on cloth, or 2*s.* 6*d.* on cloth dissected.

LIKE other maps in this excellent series, this of the Lake District is reduced from the Ordnance Survey, and has been revised to date. The map is coloured in the now familiar browns and greens, and in consequence the surface relief can be understood with ease. All details likely to be required by tourists and sportsmen are indicated, and altogether this sheet well maintains the high reputation of the series.

LETTERS TO THE EDITOR.

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

The Falling Birth-rate.

IN her lecture, delivered at University College, London, on February 25, Miss Elderton, of the Galton Laboratory, in dealing with the falling birth-rate, pointed out that the decrease is least acute in the mining districts; the engineering trades, which represent the best paid of the artisan class, come next; while textile districts coincide with residential districts in showing the biggest decrease; and she asks if there is some cause which operates to a special degree in certain classes.

One important operating cause, no doubt, is the large and increasing number of women employed in the textile trades. On the other hand, with the exception of a few pit-brow girls, practically no females are employed in the mining and engineering industries; and it is, therefore, perhaps scarcely surprising to find a greater birth-rate amongst the wives of miners and engineers than amongst the women in the cotton and woollen districts. The married woman operative in the Lancashire cotton mills, for example, knows that each new addition to the family entails some weeks' loss of work and wages before and after her confinement, and it also means an increased weekly charge when the baby is, according to Lancashire custom, "put out to nurse"; and no doubt this knowledge acts as a considerable check upon the birth-rate.

The decrease in the residential districts is due, no doubt, in part, to the "increase in luxury of living and love of pleasure" referred to by Miss Elderton, and in part also to the comparatively large number of women who are employed in such districts in domestic service. The rise in the average marriage age must also be taken into account.

Nor must we forget the influence of education. It is worthy of note that the fall in the birth-rate in this country practically dates from the passing of the Education Act in 1870. This new influence would make itself felt in a variety of ways. The check on the employment of child labour, for example, would tend to act as a check on the birth-rate, for whereas formerly children became wage-earners at a very tender age, they would, after the passing of the Act, not only cease to be wage-earners, but would actually be an increased charge on the parents. The increase in the knowledge of physiology, which has spread in recent years as a result of free education, may also not be without its influence.

Yet another factor—again ascribable not very indirectly to free education—is the change in religious sentiment which has been so pronounced during the last quarter of a century. Among other things, people are beginning to doubt whether, in these days, the "quiver full" of children is the unqualified blessing which the Psalmist declared it to be. They are realising that it is better to be the parent of two or three children, well provided for, than of a half-score or so of starvelings.

Miss Elderton also tells us that "a further analysis of figures for several northern towns shows generally that the higher the wages the smaller the family." This is exactly what, other things being equal, one

would expect. If we look to the animal world we shall, broadly speaking, find that as we rise from the lowliest to the highest organisms, there is a steady decrease in the number of offspring, while at the same time there is a lengthening of the period during which the offspring remain under the care of the parents. In the case of the human race we find that increasing civilisation brings with it a decreasing birth-rate, and a lengthening period of "schooling" for the children; and it is amongst the least intelligent (which is also usually the lowest paid) section of the community that the birth-rate is the highest. A glance at the birth-rate of our English towns will show that in those districts where there is greatest poverty and congestion, there tends to be also a comparatively large birth-rate.

The foregoing views would seem to be borne out by the fact which Miss Elderton mentions, that Liverpool, "which is not a cotton town, and where the amount of irregular and casual labour is singularly large, is one of the two cases in Lancashire where the birth-rate shows a rising tendency," and also by her statement that "from Bradford figures have been obtained showing how in homes where the mother's health or habits are bad, or where the ventilation is bad, there is on an average about one child more than in homes where these features are good."

To quote the words of Dr. Saleeby, "a chief factor of progress has been the supersession of the quantitative by the qualitative criterion of survival-value. The principle of the fall of the birth-rate is one of the great consistent facts of organic history, and may be traced from the bacteria upwards, through such representative invertebrates as the insects, even through fishes, the first vertebrates, up to man, and amongst the various nations and strata of human society. The tendency of progress, in short—a tendency coincident with the evolution of ever higher and higher species—is to pass from the horrible Gargantuan wastefulness of the older methods towards the evident but yet lamentably unrealised ideal—that every child born shall reach maturity. . . . All organic history proves that a low birth-rate is a mark of high vital level." J. ANDERSON.

17 Laburnum Road, Gorton, Manchester,
March 5.

THE above letter contains no addition of any ascertained *fact* to those cited by Miss Elderton. Miss Elderton, in her lecture, brought forward a very large amount of evidence to show that the *net* family of the socially less valuable members of the working-classes was larger than that of the socially more valuable members of the same classes. That within a given species the individuals of inferior physique and mentality have relatively greater fertility must mean the degeneration of that species; and no scientific argument can be opposed to this based upon the illogically extended syllogism: "higher" species have lower birth-rates; there is a lower birth-rate in the more valuable members of the artisan classes; hence this tends to convert those classes and their nation into "higher" types of life.

If we start to reason from analogy of this kind, we might argue that the elephant would in the end supplant man, or that the mastodon—for aught we can say to the contrary—ought to have survived all his contemporaries. It is the old fallacy of the Neo-Malthusians, who have never made any real attempt to grasp the race suicide involved in the survival of the unfit by reproductive selection—*i.e.* by their greater fertility, when it is unchecked by natural selection. Argument from analogy, when data are available, is always idle; argument from what is known of species to what must hold of individuals is still more fallacious.

Lastly, association is not causation; a "higher" individual may have fewer children, but this does not demonstrate that his height (however that vague word be defined) is produced by his lesser fertility, or that a race with a large section of its "higher" individuals practically sterile will survive in the battle of nations. History shows many cases of the decline of nations whose intellectually abler members were sterile. I can recall no case of a race with a very low birth-rate maintaining or creating a position for itself in the assembly of nations.

I have not trespassed on your space by commenting on Mr. Anderson's other statements. He was clearly not present at Miss Elderton's lecture, or he would have been aware that her data were all based on *married* women, and had due reference to their *ages*. While the actual birth-rate of wives, fifteen to forty-five years of age, has fallen 30 per cent. to 50 per cent., the *potential* birth-rate of the same wives has fallen a few points, or in many districts not at all.

KARL PEARSON.

Galton Laboratory for National Eugenics,
University of London, March 11.

The Radio-Elements and the Periodic Law.

IN his letter in NATURE of March 20 Mr. Soddy states that "granting the possibility of the existence of groups of elements with identical chemical properties and spectra, the only known direct manner in which the existence of the members of these groups could be separately recognised is radio-active evidence." I should like to suggest that another possible method of distinguishing such elements is provided by their characteristic X-radiation. According to Rutherford, the γ-radiation emitted by a radio-active element is identical with its characteristic X-radiation; is the γ-radiation of thorium D identical with the characteristic X-radiation of thallium, or the γ-radiation of radium D with the characteristic X-radiation of lead? From such experimental results as I can discover after a brief search, it would appear that the answer to this question is in the negative.

It seems probable that a difference might exist between the characteristic X-radiations of elements chemically identical, for the properties of that radiation, like the radio-active properties, are probably determined by the fixed electrons, forming part of the permanent structure of the atom, since both sets of properties are independent of chemical combination; on the other hand, the chemical properties are probably determined by the valency electrons which are readily detached from the atom. If chemically identical elements have the same spectra, it would appear that the spectra are also determined by the valency electrons, a conclusion contrary to that involved in Stark's theory of the origin of spectra.

NORMAN R. CAMPBELL.

Leeds, March 23.

The Occurrence of the Archiannelid, Protodrilus, on the South Coast of England.

THE discovery of the presence of the Archiannelid, Protodrilus, on the English coast is an interesting fact inasmuch as it extends the known domain of a genus of an archaic group of animals, and also adds a valuable animal to our records. So far as is known

Protodrilus appears to inhabit only the European seas,[1] having been taken in the Black Sea, the Mediterranean, at Heligoland in the North Sea, and at Ambleteuse, on the French side of the Straits of Dover. Protodrilus was found on March 2 in a small bay just outside and to the east of Plymouth Sound. On March 11 the spot was again visited, and a large number of specimens, more than a hundred, gathered in about an hour. The animals were found almost at the high-water mark among stones and gravel at a point where a small stream of fresh water runs into the sea.

It is an interesting fact that the animals are immersed at one period in practically fresh water, and at another period in sea water; samples of the water in which the animals were living taken at low water during the neap and spring tides were found to have densities as indicated by a hydrometer of about 1·001 and 1·009 respectively; while the density of a sample of sea water taken just outside the breakwater at Plymouth, estimated by the same instrument, was found to be about 1·025.[2]

These specimens of Protodrilus are undoubtedly different from those previously taken at Ambleteuse and Heligoland, but they resemble in some characters both the Mediterranean forms, *Protodrilus flavocapitatus*, Uljanin, and *Protodrilus spongioides*, Pierantoni. The former of these species occurs in situations which are never covered by more than a few decimetres of water, while the latter is represented by only four specimens taken from fresh water. A fuller investigation of the English specimens is being undertaken in order to compare them in more detail with the known species of this genus.

The English Protodrilus were living in the situation described above along with *Gammarus marinus*, an Oligochæte and *Gunda* (*Procerodes*) *ulvae*; the latter of these species was first taken in this spot in great numbers two years ago, and does not appear to have been recorded previously on the English coast.

J. H. ORTON.

The Laboratory, Citadel Hill, Plymouth.

On the Gain of Definition obtained by Moving a Telescope.

THE following is an account of a very singular fact which came recently under my notice, and for the explanation of which I am absolutely at a loss.

I am in the habit of rating my chronometer by means of the time-ball dropped at the Greenwich Royal Observatory, about $3\frac{1}{8}$ miles away, a signal which I observe in a small hand telescope.

On March 11, the weather being misty, I failed to pick the signal post, although I knew exactly where it was, and had placed the telescope exactly in the right direction. I moved the telescope a little, thinking I had displaced it in putting my eye to the eyepiece, and I immediately saw, very dimly, the dome of the observatory, and the signal, with the ball at half-mast, and noticed that *they were in the centre of the field all the time*. As soon as I steadied the telescope, however, they vanished completely. They reappeared as soon as I began to "sweep" for them, but remained discernible only while the motion lasted. I repeated the experiment several times; the signal was really invisible while the telescope was fixed, but by imparting to it a slow oscillation right and left I kept the signal in view with sufficient distinctness to see the ball drop, although I was not certain it had really dropped until a second or so afterwards, owing to the great faintness of the image observed.

I recollected then that, often, in similar conditions of seeing, having picked the signal without any difficulty *while "sweeping" for it*. I had failed to see it afterwards, and gave up the attempt, thinking I had been mistaken, or that the mist had become thicker. I have therefore no doubt as to this most curious and inexplicable fact: an indistinct object is better seen in a slowly moving telescope than in the same telescope when kept steady. There must be a very interesting physiological property of the eye involved in producing this result, which is quite in opposition with what one would naturally expect. Perhaps some of your readers have noticed something similar, and could throw a little light on this mysterious phenomenon.

M. E. J. GHEURY.

Woolwich Polytechnic, March 15.

Four-horned Sheep.

MR. RITCHIE'S note on four-horned sheep in NATURE of March 6 is interesting, but I am inclined to doubt whether there ever was, in Scotland or any other country, a breed in which four horns are normal. No doubt it is possible to fix this character in the male sex by careful selection, as has been done by some breeders of the spotted or Barbary sheep (sometimes called Spanish, Syrian, or Zulu sheep); but even these have not succeeded in fixing the character in the female sex. I have evidence, in the shape of specimens or photographs, of the existence of four-horned sheep in North and South Africa, Mongolia, China, the Himalayas, Baluchistan, and Chile. The Iceland breed was supposed to be four-horned, and no doubt four-horned examples were often found amongst them, a specimen I have being precisely similar in type to an abnormally four-horned Shetland.

My own experience of four-horned rams is that in most cases the lower horns, and in some cases the upper also, require to be cut at some time in their life to prevent them from growing into the cheek, or below the jaw, so that the animal cannot graze; and this no doubt would have a tendency to eliminate the four-horned rams where not specially selected. No instance is on record, so far as I know, of any wild sheep having more than two horns, neither have I seen any skull of domestic sheep in which there were more than four horn-cores, though five-, six-, and even eight-horned sheep have been recorded.

H. J. ELWES.

Colesborne Park, near Cheltenham, March 14.

THE EXPERIMENTAL STUDY OF FLUID MOTION.[1]

MANY attempts have been made to study the motion of fluids past an obstacle by experimental methods, and experiments made for this purpose may be divided roughly into two classes:

(*a*) Those in which the fluid is made to flow

[1] U. Pierantoni, "Fauna und Flora des Golfes von Neapel." Vol. xxxi. Protodrilus. 1908.

[2] These values of density were made at temperatures between 15° and 17° C., and are to be regarded as approximations only to the absolute density: as the water in which the Protodrilus were living would be constantly changing, it was not considered worth while to analyse accurately two random samples.

[1] The figures which accompany this article are from the Technical Report of the Advisory Committee for Aëronautics for the year 1911–12, and are reproduced with the permission of the Controller of H.M. Stationery Office.

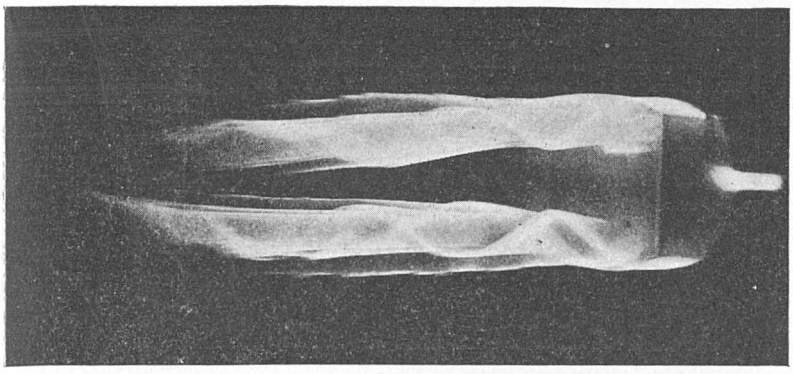

FIG. 1.—Low velocity type of flow. Air.

through a channel past a model which is fixed in the channel.

(*b*) Those in which the fluid is at rest in the channel, the model being moved relatively to the fluid and channel.

In both methods great difficulties are met with if the velocity of flow be high, owing to the rapid movements of the fluid, but in the first method the fact that in a channel the flow becomes turbulent when the critical velocity is reached

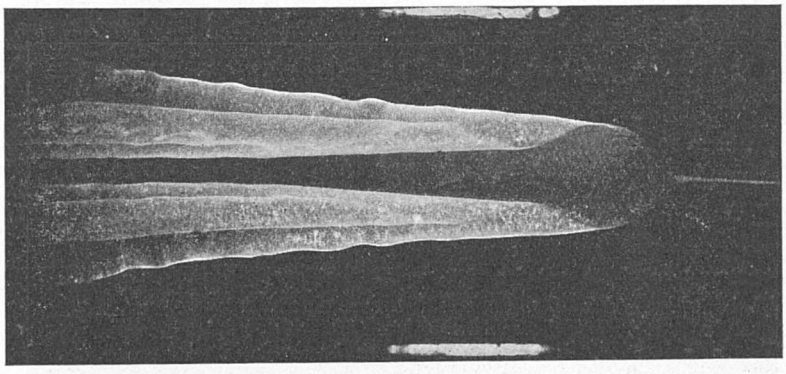

FIG. 3.—Low velocity type of flow. Water.

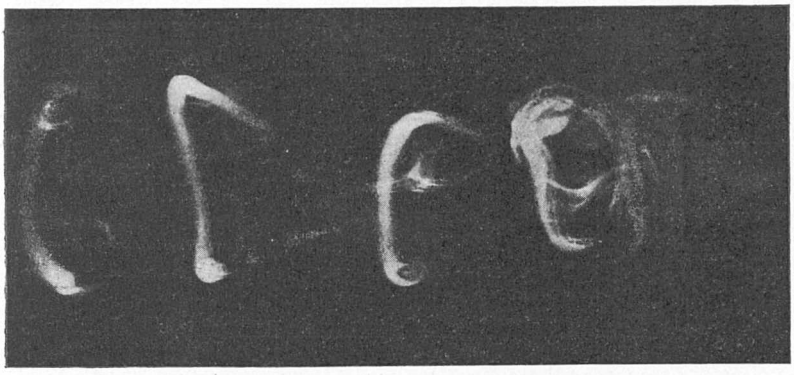

FIG. 2.—High velocity type of flow. Air.

makes observation at high velocities almost impossible.

During the past two years a research on fluid motion has been in progress at the National Physical Laboratory, and a brief description of some of the experiments which have been described in the report of the Advisory Committee for Aëronautics may be of interest.

The Teddington experiments have all been made in the "flowing fluid" type of channel, the flow in both air and water being studied at velocities below the critical velocities of the channels used.

A number of methods for indicating the direction of motion of the fluids have been tried, and, up to the present time, the best results have been obtained:

1. *In air,* by allowing tobacco smoke to issue from a jet at the velocity of the surrounding air stream, on the upstream side of the model under investigation.

2. *In water:*

(*a*) By coating the model with condensed milk, which is washed off into the eddying regions, making visible the movements of the fluid in those regions.

(*b*) By introducing minute particles of oil (aniline and toluene) of the same density as the surrounding water, the direction of motion of these particles being recorded photo-

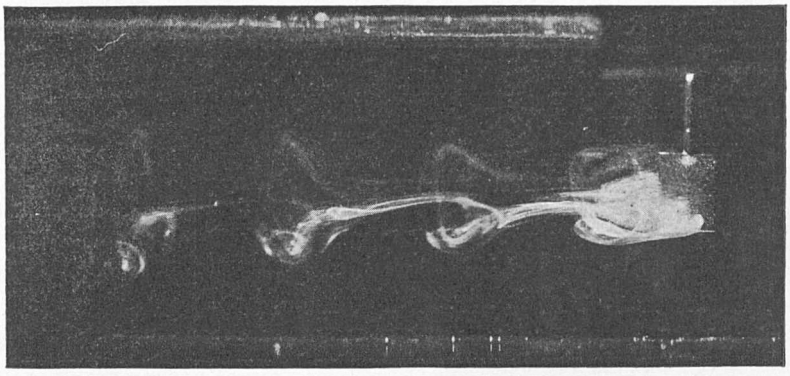

FIG. 4.—High velocity type of flow. Water.

graphically. It should be noted that these photographs, which are short-time exposures, indicate not only the direction of motion in any region, but also the velocity of motion, which is obtained from measurement of the length of the lines, comparison being made with the length of the lines in the open channel where the velocity is known.

Some examples of the results obtained are shown in the accompanying photographs, which are taken from the report of the Advisory Committee for Aeronautics, 1911–12.

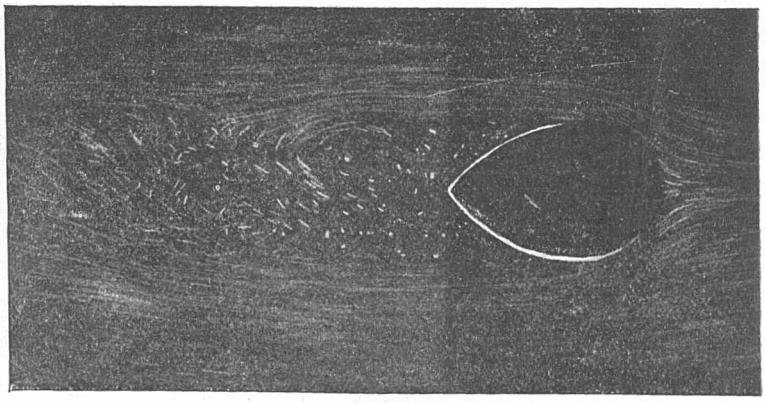

FIG. 7.—De Havilland strut.

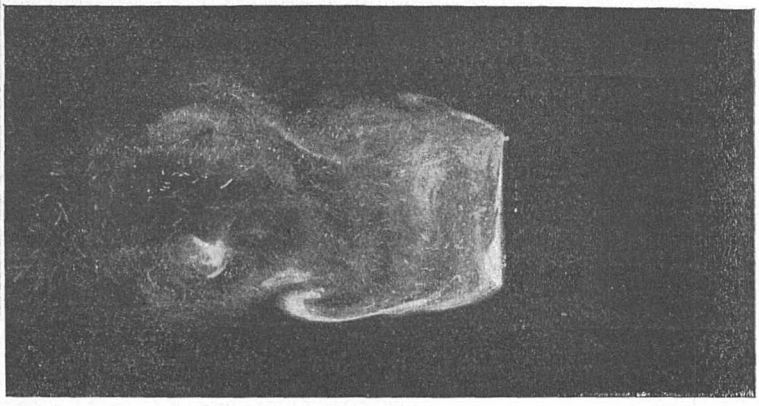

FIG. 5.—Flat plate.

Figs. 1 and 2 show the flow past an inclined square plate in air at two different velocities (by method 1). Figs. 3 and 4 show the same types of flow in water (by method 2 [*a*]). Figs. 5 and 6 show the flow past a plate in water (by methods 2 [*a*] and [*b*]). Fig 7 shows the flow past a strut in water (by method 2 [*b*]). Fig. 8 shows the dead region which exists, even at low velocities, at the tail of an airship model.

The last figure is of some interest, as it has been found that where a dead region exists at the tail of a fish-form model, the resistance of the model is not appreciably affected by the shape of the tail within this region, and so long as the tail is sufficiently blunt to cause the formation of "dead air" (as is usually the case in airships, aëroplane hulls, struts, etc.) it is convenient for constructional reasons to end the tail rather abruptly once the boundary of the dead region has been passed.

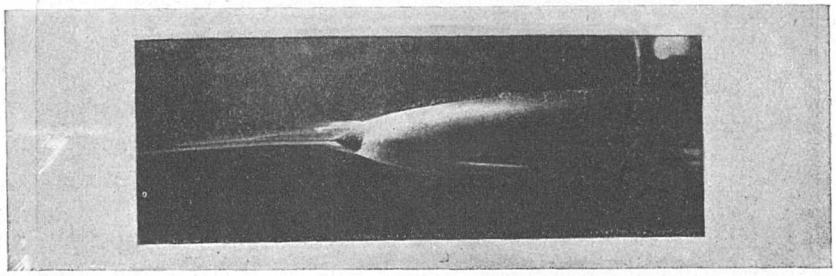

FIG. 8.—Dead region at the tail of an airship model.

A dead region is always an indication of high resistance, and is therefore undesirable.

It is hoped that observation of the flow past models, together with resistance measurements,

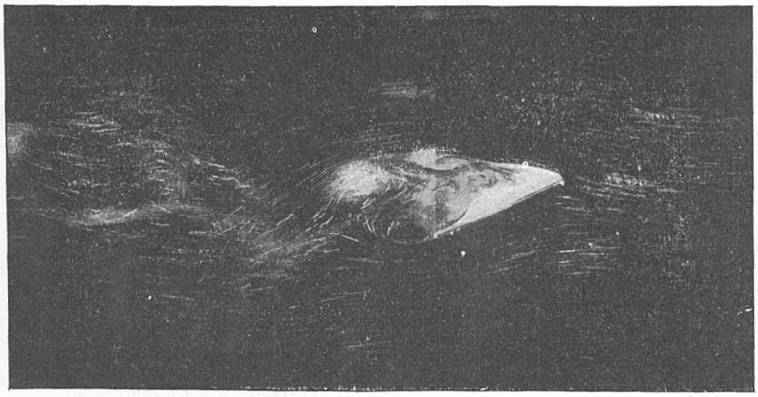

FIG. 6.—Flat plate.

will in the near future supply the data necessary to enable the designer of aircraft to construct fish-form bodies of low resistance and high efficiency.

C. G. E.

LIVINGSTONE AS A MAN OF SCIENCE.

NOW, as in the year 1874, which followed his death, discussions are being carried on as to whether Livingstone was more a missionary of religion than a man of science or an enthusiastic and skilful geographer. Such contentions are a waste of argument. Livingstone ardently believed in the supreme value of Christian ethics and the power of undenominational, basic Christianity to raise the backward peoples to a happier condition of life; but to his broad mind—a mind fifty years in advance of most of its contemporaries—reasonable religion and honest science were the same thing. Most of the dogmas of his day—for which people were still being persecuted—he tacitly ignored as being either unprovable or so little essential to "true religion and undefiled" as not to be worth discussion.

If Livingstone had lived seventy years later, he would probably have sought for some science scholarship or endowment and have gone out in his religious search for knowledge as a layman, a layman of that most holy profession, the healer of disease. He had about him the making of another Darwin. As it was, he chose the path of the missionary, and fortunately selected that missionary society (the London) which had already produced men like Campbell and Moffat, and which left with its agents singular freedom of movement and judgment. Consequently, he was able to enrich science with much material for the comprehension of Africa, even when working as a missionary at a modest salary of 100*l.* a year.

No one has ever charged Livingstone with neglecting to do the work of this profession. He taught, he expounded, he translated, pleaded; and exercised a most potent influence for good over the minds of thousands of savages; impressing their chiefs, moreover, so strongly with the worth of his character and the exemplar of his own hard-working, blameless life, that he really laid firm foundations for the Christian civilisation which has now laid hold on Bechuanaland. But from the moment of landing in South Africa he stored up all the observations he could put into writing on the African flora, fauna, geology and native races.

A review of his work as a practical philanthropist, a consul and a geographer has been already dealt with by various writers during the month which preceded the centenary celebrations. Perhaps the best and the most novel treatment of these aspects of Livingstone is that given in three articles by Mr. Ralph Durand in *The African Mail*. *The British Medical Journal* has published an essay on the medical and surgical skill of Livingstone and his great ability in this profession, besides his anticipation of the modern treatment of malarial fever and the cogency of his researches into tsetse-fly disease. To get an all-round view of the capacity of this remarkable man there only remains to be considered his quality in other branches of scientific research—philology, ethnology, zoology, botany, geology and meteorology.

In about a year after arriving in South Africa he had mastered the Sechuana language and had acquired a vehicle for conversation with the tribes between the Orange River and the Upper Zambezi, the Limpopo and Lake Ngami; for many of the Bushmen could speak some Sechuana dialect, and the conquests of the Makalolo (a Basuto tribe) had carried the Sechuana tongue northwards almost to the verge of the Congo basin. But Livingstone, appreciating the great interest which the Bantu language-family possessed for philologists, busily collected vocabularies of the still little-known languages of Ngamiland and the western Zambezi; and though these are either stored at the Grey Library at Capetown or lost, they served the purposes of Dr. W. I. Bleek in assisting him to compose his unfinished "Comparative Grammar of the South African Languages." Ethnology owes a great debt to David Livingstone. It is impossible to write on the races of South Africa without quoting from his stores of information—information which is exact, unemotional, graphic and discerning. He wrote on the Stone Age in Central Africa before anyone had thought of such a period in negro culture; on the ancientness of pottery among the Bantu; on the domestic animals of south Central Africa; on fragments of unwritten history and half-forgotten migrations; on the importance of the Pleiades as a measurer of the seasons in the eyes of the African agricultural folk; on the racial and cultural influence of ancient Egypt on negroland.

His notes on the life-history and habits of the lion, ratel, giraffe, rhinoceros, buffalo, elephant, giant chimpanzi, baboon, hippopotamus, zebra, lechwe, situtunga, and the other striking mammals of southern and Central Africa, are strewn through his three published books, and have done good service in many a natural history book. No succeeding naturalist traveller has called his information in question. Amongst his discoveries in zoology were several antelopes and the pygmy elephant of the Congo forests, "a small variety, only 5ft. 8 in. high, yet with tusks 6 ft. 8 in. in length." (This form was only rediscovered by the Germans a few years ago.) Livingstone's notes on birds, lizards, snakes and frogs are as good reading and as accurate as those on mammals. His observations on the part played in the economy of nature by the termites (which consume and cover with soil all dead timber) were subsequently confirmed and elaborated by the late Prof. Henry Drummond.

Livingstone's botanical collections and innumerable botanical notes—more especially about the Zambezian flora—are incorporated in the old and the new editions of the "Flora of Tropical Africa." His discovery of fossil Araucarias in the rocks of the Central Zambezi valley led him to guess

at the ancient connection between South Africa, Australia and South America. His sketch of the geology of Central Africa, written in 1857, his description of the former plutonic activities of the south-west Tanganyika region, of the coal-bearing strata of the Ruvuma and west Nyasaland, and his hearsay reports of the gold and copper of Katanga have stood the test of time in their substantial accuracy. His meteorological records of the rainfall, temperature and climate of Central Africa still await publication.

Indeed, it is possible that much of Livingstone's scientific research work has never yet been published, and that when it is disinterred and printed we may find ourselves still further indebted to this missionary-consul-explorer for valuable information about the southern third of Africa.

H. H. JOHNSTON.

PLANT DISEASES AND INSECT PESTS.

MOST of the investigations on this subject are carried out at agricultural research institutions and have for their primary object the discovery of means for destroying the pest, rather than the elucidation of the relationship between the host and the parasite. Yet the latter problem must be of extraordinary interest, and we can only hope that the investigators will turn to it as soon as some of their pressing economic problems are solved.

Of the British Colonial departments, the West Indian is among the most prolific in publications on these subjects. The papers are issued in the reports of the various schools and departments and in *The West Indian Bulletin*. No. 4, vol. xii., of this journal contains papers by H. A. Ballou, J. R. Bovell, and F. W. South on the use of entomogenous fungi in combating scale insects in Barbados, one of the most interesting methods of pitting one organism against another for the benefit of mankind. Fungi parasitic on the insects are cultivated and the spores distributed: they are then applied to the insects directly these appear on the tree. The authors are very hopeful about the method; one, indeed, thinks it may enable most of the insect pests to be kept in check.

The bud rot of the cocoa-nut palm, described by J. B. Rorer in another paper, is an interesting example of a bacterial disease of plants. The disease has been much studied in the United States by Johnston (Bull. 228, U.S. Dept. of Agriculture), who comes to the remarkable conclusion that it is caused by *Bacillus coli*.

The United States Department of Agriculture and the entomological laboratories of the various colleges are, however, by far the most active investigators of plant diseases and insect pests. From the department itself issues a continuous stream of publications which we cannot pretend adequately to review. A. L. Quaintance has recently, in Circular 154, described the leaf blister mite (*Eriophyes pyri*, Pagenstecher), one of the smallest animals (they are not true insects) attacking horticultural crops. H. M. Russell, in Circular 151, deals with the greenhouse thrips (*Heliothrips haemorrhoidalis*, Bouché), which does considerable damage in attacking ornamental plants. E. S. Tucker, in Circular 152, describes the rice water-weevil (*Lissorhoptrus simplex*, Say), the larvæ of which feed on the roots of rice plants, while the adult weevils cause some harm by feeding on the rice leaves; altogether, this insect is regarded as the most serious enemy of rice in the southern States.

The Hawaiian Station has issued an account of Dr. Lyons's investigation of the curious sugar-cane disease known as *iliau*, endemic in the island and not known elsewhere. He traces it to a fungus producing two types of fruiting bodies: a perfect form belonging to the genus Gnomonia and an imperfect form referable to the genus Melanconium; he proposes to call it *Gnomonia iliau*.

NOTES.

THE ninth International Congress of Zoology now sitting at Monaco, under the presidency of H.S.H. the Prince of Monaco, was opened on Tuesday at the Oceanographical Museum. There are seven sections and one subsection, as follows:—(1) Comparative Anatomy and Physiology; (2) Cytology and General Embryology; (3) Systematic Zoology; (4) General Zoology, Palæozoology, and Zoogeography; (5) Oceanographical Zoology and Plankton; (6) Applied Zoology, Parasitology, and Museums; (7) Zoological Nomenclature; subsection, Entomology. Every consideration for the convenience and comfort of members has been given. The sections meet in the Oceanographical Museum and Lyceum, close by. The common subject of conversation of members is concerning zoological nomenclature; we learn that there have been several preliminary unofficial meetings, and that proposals are forthcoming which will probably result in a decision satisfactory to zoologists in general. The Prince of Monaco opened the proceedings on Tuesday at 6 p.m., after which there was a reception in the museum. The programme shows that there are many and interesting communications. British membership on the opening day exceeds eighty out of a total of 723, the largest yet recorded for any international zoological congress. There is, however, not a proportionate number of British communications; those on the list on Monday were by Prof. Elliot Smith, of Manchester; Prof. J. Arthur Thomson, of Aberdeen; Dr. R. F. Scharff, of Dublin; Mr. E. Hall, of London; Dr. E. J. O. Hartert, of Tring; Dr. W. S. Bruce, of Edinburgh; Dr. M. Annandale and Dr. B. L. Chandhuri, of Calcutta; Dr. R. J. Anderson, of Galway; and Dr. Hornell, of Madras. Lord Walsingham will move an important resolution on zoological nomenclature, and among British members who are likely to take part in this discussion are Dr. S. F. Harmer and the Hon. Walter Rothschild.

EXCEPTIONALLY wild and stormy weather was experienced over the south of England on Saturday, March 22. A severe thunderstorm occurred in the

southern counties in the afternoon, and this was followed by a brisk freshening of the wind, which developed during the evening to a violent gale. At 6 p.m. the centre of the storm was over Cornwall, and by 7 a.m. on Sunday morning it had reached Berwick, the disturbance progressing at the rate of more than forty miles an hour. A velocity of sixty-three miles an hour was attained by the wind at Kew at 8.50 p.m., and at 10.35 p.m. the hourly velocity was sixty-five miles an hour. On the south coast of England, where the greatest force of the gale was experienced, the wind attained the velocity of seventy to seventy-five miles an hour. The storm is probably the worst experienced for about the last eight years. Shortly before midnight the wind and sea carried away about 200 yards of the pier at Worthing. Much damage was wrought at Bungalow Town, near Shoreham, and also at Hythe, in Kent.

A SEVERE and destructive tornado occurred in the United States on the evening of Sunday, March 23. The greatest damage was done at Omaha, Nebraska, where about 150 people are said to have been killed and many more injured. The tornado swept the central States, and damage is reported from many places. Blocks of buildings were wrecked, and trains are reported to have been torn from the rails. Fire occurred in the wake of the tornado, and the torrential rain which followed the storm helped materially in extinguishing numerous conflagrations. The path traversed by the tornado is said to have been between 200 and 350 yards wide. At Omaha the storm is reported to have demolished one hundred and fifty houses and eleven churches. A report from Indianapolis states that owing to heavy rains following the tornado, the rivers in the State have overflowed their banks, and it is feared that there will be the worst floods for years. Several towns are reported as submerged.

ON Tuesday next, April 1, Dr. A. Smith Woodward will begin a course of two lectures at the Royal Institution on recent discoveries of early man, and on Thursday, April 3, Dr. E. Frankland Armstrong will begin a course of two lectures on (1) the bridge into life, (2) colour in flowers. The Friday evening discourse on April 4 will be delivered by Dr. J. J. Dobbie on the spectroscope in organic chemistry, and on April 11 by Mr. C. J. P. Cave, on the winds in the free air.

THE second circular of the International Geological Congress, 1913, has recently been issued. A change in the date of the sessions is notified: the meetings of the congress will begin at Toronto on Thursday, August 7, instead of August 21, as previously announced, and will terminate on August 14. The principal subject selected for discussion is "The Coal Resources of the World," and following the excellent precedent of the Stockholm congress, a large monograph on this subject will be prepared. The response from all over the world has been so cordial that the committee hopes to have the two quarto volumes and folio atlas ready in time for the meetings. The price will be twenty dollars the set. Other topics to be discussed are:—(2) Differentiation in igneous magmas; (3) the influence of depth on the character of metalliferous deposits; (4) the origin and extent of the pre-Cambrian sedimentaries; (5) the subdivisions, correlation, and terminology of the pre-Cambrian; (6) to what extent was the Ice age broken by interglacial periods?; (7) the physical and faunal characteristics of the Palæozoic seas, with reference to the value of the recurrence of seas in establishing geological systems. Authors of papers are specially invited to bring specimens to illustrate them, for which ample space will be provided, and the Department of Customs will give facilities for their entry into Canada duty free. A magnificent series of excursions has been planned, which will give an insight into the general geology, and particularly the glacial, pre-Cambrian, and economic geology of Canada. Twelve of these will take place before the congress; ten short excursions will be held during the congress and nine after. The first excursion starts from Montreal on July 13, and the longest of the post-congress excursions will reach Vancouver on September 22. Particulars may be obtained from the secretary of the congress, Victoria Museum, Ottawa, or from any geological society or survey.

MUCH attention is now being paid to the archæological remains in Jersey. In Bulletin No. 3 for 1912 of the Société d'Anthropologie de Paris, Dr. Deyrolle and Capt. Mauger describe the excavation of the tumulus and dolmen known as Teste-du-fief, in the northern part of the island. The owner has wisely decided that, after being opened, the monument is to be, so far as possible, preserved for examination by visitors, in its original condition. Within the dolmen the remains of a man buried beside his horse were discovered. Close to the right hand of the corpse was a small clay vessel, and close by a collection of horse teeth. Further information regarding this important discovery will be awaited with interest.

WE have received a copy of the first number of *Der Fischerbote* (Hamburg) for 1913, which contains much interesting information with regard to German fisheries, both in Europe and East Africa.

A VERY interesting new generic type of side-necked (pleurodiran) tortoise from the Keuper, in the neighbourhood of Stuttgart, is described by Prof. O. Fraas in *Jahresheft Ver. vat. Naturk. Württ.*, 1913, No. 80, under the name of *Proterochersis robusta*. Its peculiarity consists in the presence of two complete pairs of mesoplastral elements in the lower shell, which is believed to be a unique feature in the order. As a mesoplastron seems to be a primitive feature, its duplication appears to represent a still more archaic type. In vol. lx. of the "Palæontographica" (pp. 275–294) the same writer describes several new large labyrinthodonts from the Swabian Trias, one of which is referred to Cyclotosaurus, based on Meyer's *Capitosaurus robustus*, the genus also including the so-called *Capitosaurus stantonensis*, of the Warwickshire Keuper.

The American Naturalist for February contains four addresses on organic and inorganic adaptation in nature, delivered at the Symposium on this subject, at

the meeting of the American Society of Naturalists at Cleveland on January 2, and a fifth on the fitness of the environment, being an inquiry into the biological significance of the properties. In the first Prof. Mayfield discusses adaptation through natural selection and orthogenesis, and in the second Prof. Livingston adaptation in the living and non-living, while in the third Prof. Parker considers adaptation in connection with animal reaction, and in the fourth Prof. Mathews reviews the subject from the point of view of the physiologist. As our readers may wonder what is meant by non-living adaptation, it may be mentioned that Prof. Livingston cites the case of pumice fragments in an inundation of the Colorado river. "Had it not been for the floating adaptation, these pumice-pebbles would have suffered temporary extinction in the form of submergence, and would not have been able . . . to gain dominance . . . in certain . . . beaches."

WE have received a copy of the issue of February 7 of an apparently new journal, published by the California Associated Societies for the Conservation of Wild Life at San Francisco, under the title of *Western Wild Life Call*. California, it seems, is one of the States in which wild-killed game is still permitted to be sold, and it is one of the main objects of the new venture to obtain the total prohibition of this branch of trade. Among the species or races of animals in imminent danger of extermination in California, even if some of them have not been already killed off, are the wood-duck, the sharp-tailed duck, the prongbuck, two kinds of wapiti, the beaver, and the sea-elephant. The fate which has already overtaken the passenger-pigeon is now threatening the band-tailed pigeon (*Columba fasciata*) in California, a species which has somewhat similar habits, and is now being slaughtered in enormous numbers. So urgent is the case that total prohibition for a period of at least five years, and subsequently an annual close season, are deemed necessary.

APROPOS of the correspondence which we have recently had on "retinal shadows," Mr. J. L. Herrick writes suggesting an explanation of the twinkling of distant lights. He has noticed at his home in Yonkers, New York, where there are many street lamps at different distances, that only the more distant lights twinkle, and he thinks that the occultation of the lights may be due to blood corpuscles in the retinal vessels. He applies the same explanation to the twinkling of stars. The latter phenomenon has received many explanations, physical and physiological. With regard to the latter, the subject was brought to the notice of the Physiological Society some years ago by Dr. J. S. Haldane, and was discussed by the members. Several suggestions were advanced, amongst others that it was due to the pulse waves in the retinal vessels. No adequate proof of any of the physiological theories was brought forward, and it is doubtful whether any theory yet adduced amounts to more than a plausible hypothesis.

A REPORT of the experiments carried out for the Durham County Council, on the feeding of dairy cows, has been published in bulletin form (Offerton Bulletin No. 4), by Mr. F. P. Walker. The experiments include a comparison of soya cake with decorticated cotton cake, and Sudan dura with maize. In the former case soya cake gave, if anything, slightly better results than cotton cake, and in the latter dura was shown to be equal in value as a food to maize, and might profitably be adopted as a substitute in times of low prevailing prices. Other experiments with "crowdy" or watery foods as against concentrated foods tend to show that, on the whole, the quantity and quality of the milk are not affected. A possible action of "crowdy" rations in maintaining the flow of milk for a longer period than dry rations is indicated.

DR. E. J. RUSSELL and Mr. F. R. Petherbridge contribute a paper to the January number of the Journal of the Board of Agriculture on the sterilisation of the soil for glasshouse work. In continuation of earlier experiments on this interesting and complex problem, the authors have investigated the influence of heat and numerous antiseptics on the fertility of tomato-, cucumber-, and vine-sick soils, and have accumulated sufficient evidence to show that one or other of the various modes of treatment might be distinctly useful to practical growers. The effects of treatment may be attributed, in general, to the following changes:—(1) An increased bacterial activity with greater food production; (2) the reduction in numbers or death of disease organisms; (3) a modification of processes going on in the soil, so that certain unusual substances are present which produce special effects on the plant. These lead to early maturity and greater yields of tomatoes, early maturity in the case of cucumbers, and darker green and larger foliage and larger and brighter flowers with chrysanthemums. The best results were obtained in heated soils or those treated with formaldehyde, pyridine, or the higher bases, collidine, lutidine, &c.

MR. R. KIRKPATRICK, after zealous travel, considerable reading of recent geological literature, and painstaking observation, publishes a pamphlet entitled "The Nummulosphere" (Lamley and Co., London, 1913). In this he attempts to resuscitate Eozöon by finding structures of a discoidal nature common to it, to nummulites, and to almost every rock that he examines. The existence of these discs in nummulites is held to prove that all these other materials, including igneous lavas and granites, are of organic origin.

STUDENTS of the British Trias will find two papers of interest in the Proceedings of the Liverpool Geological Society, vol. xi., part iii. (1912). Rev. C. E. Spicer (p. 201) writes from personal observations of "Present Trias Conditions in Australia," and Sir T. H. Holland (p. 227) describes "The Origin of Desert Salt Deposits," laying special stress on the carrying of salt as fine dust by prevalent winds across the plains of north-west India. The "red marls" of the Trias are regarded (p. 245) as oxidised representatives of the black muds stained by ferrous sulphide found in modern salt-lakes in desert lands. Reasons are given (p. 246) for regarding the wind-borne salt

as insufficient to affect Prof. J. Joly's use of the sodium in rivers and in the ocean as a measure of geological time.

FROM an educational point of view, no work issued by the United States Geological Survey has been more important than Professional Paper 71, by Mr. Bailey Willis, entitled "An Index to the Stratigraphy of North America" (1912). This memoir of 894 pages is accompanied by a coloured geological map of North America on the scale of 1 : 5,000,000, which includes, not only Mexico, the United States, and Canada, but Central America, the West Indies, Greenland, and Iceland as accessories. We should recommend the mounting of this map on large folding sheets, after the excellent manner of the Oxford wall maps, so that the whole or any of the four sections can be hung up as required. The paper is much more than an "index," since the formations are described in detail, and the views of various authors as to their modes of deposition are freely quoted. Canada is thus represented by her own authorities. The most striking features on the map are the immense areas covered by Tertiary volcanic rocks in the western Cordillera, and, in contrast, the severe pre-Cambrian region of the north-east, beyond the folded Mesozoic strata of the Rocky Mountains.

IN common with all other great earthquakes, the Messina earthquake of December 28, 1908, was followed by a large number of after-shocks. A record of the shocks felt at Messina was kept by Mr. G. Spadaro, then a student in the Nautical Institute in that city. During the last four days of 1908, eighty-seven shocks were felt, and during the following year 862. The majority of these shocks were, as usual, very slight, but four (in December, 1908, and January, 1909), were ruinous, and one (in July, 1909) almost disastrous. Dr. Agamennone points out (in the *Rivista di Astronomia*, &c., for last November) that the distribution of these shocks in time does not follow the simple law which, according to Prof. Omori, governs the decline in frequency of Japanese after-shocks, namely $y=k/(x+h)$, where y is the number of shocks in a given interval at time x, and h and k are constants, for the monthly number is greatest in March, 1909, and shows an increase in frequency towards the end of that year.

IN the *Revue générale des Sciences* for February 28 Prof. H. Devaux, of the University of Bordeaux, gives a *résumé* of his researches on the properties of thin layers of oil spread on the surfaces of water and mercury, a subject on which he has published a number of papers during the last ten years. It appears that the least thickness of oil which produces an appreciable effect on the surface tension of either water or mercury is much less than has been supposed. If a film of oil the thickness of which is known from its volume and area, is gradually thinned by increase of its area, the surface tension of the surface it covers has the value appropriate to oil until the thickness of the film, $1{\cdot}10\times10^{-7}$ centimetre, is less than the mean diameter of an oil molecule, $1{\cdot}13\times10^{-7}$ centimetre, as determined by M. Perrin's method. Below this thickness the film of oil does not affect the surface tension of either water or mercury.

THE February number of the Journal of the Institution of Electrical Engineers contains the lecture on permanent magnets which Prof. Silvanus P. Thompson delivered at the meeting of the institution at Glasgow last year. It occupies more than sixty pages, gives a complete account of present-day knowledge on the subject, and points out directions in which further research is necessary. The author shows that the most powerful and permanent magnets are made of steels with about 6 per cent. of tungsten and 0·5 per cent. of carbon, and have the ratio of length to breadth large. After forging at as low a temperature as possible the magnets should be heated to 900° C., cooled to 750° C., kept at that for a time, and then cooled off. Hardening is a repetition of this process down to 700° C., at which temperature the magnets are to be plunged into brine at 20° C. Maturing is done by boiling the magnets for ten or twelve hours. Magnetisation is effected by an electromagnet, and there is some advantage in a few reversals. For extreme constancy the magnetisation may be reduced by 5 or 10 per cent. by subjecting the magnets to demagnetising forces. The paper includes a bibliography which will prove of great use to future workers in this field.

MR. H. G. SEAGER, of Colwyn Bay, has devised an "automatic control" for aëroplanes, which appears well suited for the purpose of extricating an aviator from the difficulties in which he is placed by a sudden change of the conditions of either longitudinal or lateral equilibrium, such as that due to a gust of wind or a stoppage of the engines. It is perhaps not sufficiently realised that the initial effect of the latter cause is exactly represented by impressing on the machine a wrench equal and opposite to that of the propeller in steady motion, and if the propeller is much below the centre of gravity the result will be to turn the whole machine round until the air strikes on the top of the planes and sends the aëroplane to earth. Mr. Seager employs a pendulum, so arranged that any finite displacement exceeding a certain limit operates one or more air valves controlling pneumatic motors, and these displace the controls through a finite distance proportional to the number of valves operated on, this number depending again on the displacement of the pendulum. The arrangement has the obvious advantage that the pendulum oscillations can be damped out by friction, so that the apparatus can be adapted to an inherently stable aëroplane without interfering with its motion or control except in the case of large disturbances.

IN "Untersuchungen über die Gezeiten der feste Erde und die hypothetische Magmaschicht," a recent publication of the Geodetic Institute at Potsdam, Dr. W. Schweydar has made a very important contribution to the investigation into the nature of the earth's interior. His discussion of a long series of horizontal pendulum experiments throws considerable light on the outstanding difference between the coefficient of rigidity for the earth indicated by the Chandler motion

of the pole and that given by tidal terms of long period. Consideration of the effects of ocean tides (discussed according to the dynamical theory) upon the semi-diurnal deformation of the solid earth gives the value for the rigidity of the earth as being two or three times that of steel. This value is of the same order as is required to account for the observed wandering of the pole, and also for the diurnal tide in the solid earth. Dr. Schweydar does not set much store by Dr. Hecker's differing results for the values of the east-west and the north-south elasticity, and he gives reasons for not accepting the explanations offered by Hecker and Lallemand. On one other debatable point of much importance Dr. Schweydar's results will be read with much interest. If the earth is to be regarded as consisting of an elastic core, a viscous layer, and a rind, then he decides that this viscous layer cannot be supposed to be of the fluidity of molten metal, but must be regarded as to all practical purposes solid. It need scarcely be stated here that this was the view reached on quite other grounds by the late Sir George Darwin.

IN two papers published in the *Atti R. Accad. Lincei* (vol. xxxi., ii., pp. 740 and 803) Profs. R. Nasini and C. Porlezza describe the discovery for the first time of ozone in a natural water, and discuss the possible reasons for its presence therein. The water is that of Le Bagnore of Santa Fiora, in Monte Amiata, and the ozone is not a transitory but a permanent and normal constituent, imparting a distinct odour to the water, and being present to the extent of about 0·15 c.c. per litre. The water is not radio-active, and in default of other possible explanations, the view is put forward that the presence of ozone is due to autoxidation of ferrous bicarbonate, either *per se* or brought about by the action of the so-called iron-bacteria. The water of a spring at Bagnoli, Arcidosso, also in the Monte Amiata district, possesses similar properties, but in a minor degree. Both these waters have locally a high therapeutic reputation, and the question arises whether this is due to the ozone which they contain. Further investigations will be made to decide this and other points as to which there is still some uncertainty.

WE have received a copy of the Transactions of the English Ceramic Society, part ii., session 1911–12, which, in addition to a number of papers of technical interest to potters, contains an account, which is of more general interest, of several of the principal pottery works on the Continent. In the summer of 1912 members of the Ceramic Society made a tour of inspection of ceramic works in Holland, Germany, and Belgium, and a report of the visit, admirably illustrated by photographs, covers forty pages of the Transactions. The descriptions given of the Royal Berlin Porcelain Factory at Charlottenburg, founded by Frederick the Great in 1763, and now carried on by the Prussian Government, with 660 workmen, and of the Royal Porcelain Factory at Meissen, founded in 1710, and now employing 800 hands, are of particular interest. The writer of the report expresses regret that no such institutions exist in England :—"In Germany, should a manufacturing potter have an idea which, through lack of capital or initiative, he is unable to work out to fruition, he at once has the assistance of the State pottery to test, and, if necessary, to evolve that idea, whereas in England brains can only be utilised apparently to the accompaniment of capital and risk."

A MEMORIAL portrait of the late Capt. Scott in uniform has been published by Messrs. Maull and Fox, the proprietors of the copyright in the only photographs of the explorer in full-dress uniform. The portrait, which is a photogravure, has been approved by Lady Scott, and the publishers have undertaken to contribute an agreed proportion of the profits of the sale of the portrait to the National Fund which is being raised. The price of the portrait is 5*s*. each, and copies can be obtained through the usual trade channels, or from Messrs. Maull and Fox, 187 Piccadilly, London, W., or Messrs. S. Hildesheimer and Co., Ltd., 96 Clerkenwell Road, London.

OUR ASTRONOMICAL COLUMN.

SPECTRUM OF THE PLEIADES NEBULA.—Bulletin No. 55 of the Lowell Observatory contains an interesting account of the results secured by Mr. Slipher in the photography of the spectrum of the nebula in the Pleiades. This nebula, as Mr. Slipher points out, would doubtless naturally be classed as a gaseous nebula since in its prominent characteristics it resembles more the great nebula in Orion, the typical gaseous nebula, than the more numerous class of spiral nebulæ. However, with the 24-in. refractor of the Lowell Observatory he made an exposure of twenty-one hours, obtaining, as he states, a perfectly legible record. This spectrum was continuous and crossed by strong hydrogen lines, Hβ, Hγ, Hδ, Hε, and Hζ, and fainter helium lines, those at 4026, 4381, and 4472 (combined with 4481) being recognisable. No trace of any of the bright lines seen in the spectra of gaseous nebulæ was found, but the spectrum resembled a copy of the brighter stars of the Pleiades. The result suggested that the spectrum might be due to light from Merope scattered and reflected by the large objective. Exposures on the nebula of Orion and of a region near Sirius, led him to conclude that "the nebula shines by light, the spectrum of which is a true copy of that of the neighbouring star Merope and of the other bright stars of the Pleiades." It is suggested then that the nebula is disintegrated matter similar to what we are acquainted with in our solar system, as in the rings of Saturn, comets, &c., and that it shines by reflected light.

CHROMOSPHERIC (SOLAR) LINES IN THE SPECTRUM OF φ PERSEI.—An interesting paper by Mr. Paul W. Merril forms part of Lick Observatory Bulletin No. 224. In the course of a survey of Class B stars having bright hydrogen lines, the author has measured a number of lines, bright and dark, between λλ4340 and 6515 in spectrograms of this star, and connects these lines with "chromospheric" lines taken from Young's lists in Frost-Scheiner's "Astronomical Spectroscopy." It is to be regretted that the author has not employed a more recent authority. However, he considers the presence of "chromospheric" radiations in the stellar spectrum established. The star does not duplicate the solar chromosphere, for it is stated that the phenomena presented by helium, magnesium, and sodium are anomalously at variance with the chromospheric spectrum. This paper extends and confirms, apparently unconsciously, the conclusion previously arrived at by Sir Norman Lockyer and

Mr. F. E. Baxandall (Proc. Roy. Soc., vol. lxxiv., pp. 548–550, 1905), when many lines in the emission spectrum of μ Centauri (also an Orion star with bright hydrogen lines) were found to agree in wave-length with enhanced iron lines.

WHAT BECOMES OF THE LIGHT OF THE STARS?—This question Prof. Very, of the Westwood Observatory, Mass., U.S.A., places before the readers of *The Popular Science Monthly*, and proceeds to give an interesting answer in an essay, highly speculative in character, developed in eighteen pages of the March number. The author ably marshals a useful body of evidence tending to establish that there is a general absorption of light by the ether. In this transformation of energy he sees the genesis of matter, and in meteorites he finds the "appointed instruments" whereby the nascent dust is collected "into the germs of future worlds." By atomic disintegration like that accompanying the degradation of radio-active elements the cosmogonic process is made reversible.

It may be mentioned that in reference to the "transient nebulosity," which appeared around Nova Persei, the author states: "It was an electric phenomenon, an exhibition of canal rays, or positive ions, on a grand scale," and that to explain the high temperature of the helium stars, he makes the hypothesis that they "contain an exceptional amount of peculiarly unstable elements."

PUBLICATIONS OF THE STRASSBURG UNIVERSITY OBSERVATORY.—The second part of vol. iv. of the *Annalen der Kaiserlichen Universitäts-Sternwarte in Strassburg*, published under the direction of Dr. Bauschinger, contains a large number of observations of double stars, planets, satellites, and nebulæ. The double stars were observed with a 49-cm. refractor by Dr. Wirtz between 1902 and 1910, and the results are compared with those obtained by other observers and with the ephemerides. The same observer is also responsible for the measures of the major planets and their discussion, in which are given the diameters and other measures, such as the dimensions of the Martian snowcaps, and the positions of the *streifen* on Jupiter; for the polar and equatorial diameters of the latter planet he finds the values $35{\cdot}986'' \pm 0{\cdot}028''$ and $38{\cdot}254'' \pm 0{\cdot}030''$ respectively.

TIDE TABLES.—From the Government Astronomer of New Zealand, Mr. C. E. Adams, we have received a report of the tide observations made at Auckland since December 1, 1908. These have now been harmonically analysed, and the results are given. There is also an interesting description of a new tide gauge designed by Mr. W. Ferguson, in which the recording pencil is moved by a clock and the paper on which the record is made is moved by the tide. The gauge has been running some months, and has given great satisfaction.

From the Government Printing Bureau at Ottawa we have received copies of the tide tables for the Canadian coast for 1913. The accompanying letterpress contains many interesting facts concerning the tides on the Pacific coast.

STARS WITH VARIABLE RADIAL VELOCITIES.—Mr. J. H. Moore, of the D. C. Mills Expedition's Observatory, Santiago, Chile, gives a list (L.O. Bulletin 224) of nine stars of about 5·0 magnitude, having variable radial velocities. In the same bulletin Prof. W. W. Campbell gives observations showing that the radial velocities of δ Andromedæ and μ Cephei respectively vary between $-1{\cdot}8$ km. and $-10{\cdot}8$ km., and $+15{\cdot}6$ and $+29{\cdot}4$. The latter also makes a correction regarding the radial velocity of *i* Capricorni. In L.O. Bulletin 97 this was stated to be variable. The removal of some errors of reduction leaves the velocity apparently constant at +12 km. per second.

THE TEACHING OF MATHEMATICS.[1]

THE papers enumerated below complete those written for the recent International Congress of Mathematicians. They deal with secondary schools, girls' school, preparatory schools, the training of teachers, technical institutes, and universities. Earlier papers in the same series were described in NATURE of March 14, 1912 (p. 44), and of May 23 (p. 305).

Secondary Schools.

No. 20 is a judicial discussion of "The Calculus as a School Subject." Mr. Jackson states impartially the questions involved, some of which can only be settled by greater experience than we now possess. Some questions are already settled, *e.g.* that if the calculus is to be introduced time must be found by a reduction in the drill which now prevails in algebra and trigonometry, by a frank recognition that tangents to curves and varying velocities involve the ideas of the calculus with some knowledge of the concrete ment that follows from this recognition. It is also desirable that the pupil should come to the study of the calculus, and by giving these subjects the treat-matters to which its methods are applicable. Mr. Jackson appears to be unaware that it is useless to point out an imperfection of proof to pupils who cannot discover the imperfection for themselves; but his pedagogy is in general so good that we feel sure he does himself injustice in this apparent ignorance.

Mr. Barnard (No. 22) frankly disapproves of the methods of teaching which have resulted from Prof. Perry's movement. He is all for thoroughness, and most of his article is taken up with a list of the blunders of text-books. We gather that he attributes these blunders to the new methods, a surprising view when we consider how few men educated in the new methods are old enough to write books.

Our conclusion is different. Writers of text-books are on the whole picked men, such as university professors and the ablest schoolmasters, and they are at present men trained on the old "thorough" methods; and if such blunders are possible for these picked men, it is indeed few of the schoolboys who are fit to profit by that training.

[1] The Teaching of Mathematics in the United Kingdom. Special Reports on Education Subjects.

No. 18. "Mathematics in the Education of Girls and Women." By Miss E. R. Gwatkin, Miss Sara A. Burstall and Mrs. Henry Sidgwick. Price 2½*d.*

No. 19. "Mathematics in Scotch Schools." By Prof. G. A. Gibson. Price 3*d.*

No. 20. "The Calculus as a School Subject." By Mr. C. S. Jackson. Price 1½*d.*

No. 21. "The Relation of Mathematics to Engineering at Cambridge." By Prof. B. Hopkinson. Price 1½*d.*

No. 22. "The Teaching of Algebra in Schools." By Mr. S. Barnard. Price 1½*d.*

No. 23. "Research and Advance Study as a Training for Mathematical Teachers." By Prof. G. H. Bryan. Price 1½*d.*

No. 24. "The Teaching of Mathematics in Evening Technical Institutions." By Dr. W. E. Sumpner. Price 1*d.*

No. 25. "The Undergraduate Course in Pass Mathematics, generally, and in relation to Economics and Statistics." By Prof. A. L. Bowley. Price 1½*d.*

No. 26. "The Preliminary Mathematical Training of Technical Students." By Mr. P. Abbott. Price 1½*d.*

No. 27. "The Training of Teachers of Mathematics." By Dr. T. P. Nunn. Price 1½*d.*

No. 28. "Recent Changes in the Mathematical Tripos at Cambridge." By Mr. A. Berry. Price 1½*d.*

No. 29. "Mathematics in the Preparatory School." By Mr. E. Kitchener. Price 1½*d.*

No. 30. "Course in Mathematics for Municipal Secondary Schools." By Mr. L. M. Jones. Price 1½*d.*

No. 31. "Examinations for Mathematical Scholarships at Oxford and Cambridge." By Mr. A. E. Jolliffe and Mr. G. H. Hardy. Price 2*d.*

No. 32. "Parallel Straight Lines and the Method of Direction." By Mr. T. James Garstang. Price 1*d.*

No. 33. "Practical Mathematics at Public Schools." By Prof. H. H. Turner, Mr. R. C. Fawdry, Mr. A. W. Siddons, Mr. F. W. Sanderson, and Mr. G. M. Bell. Price 1*d.*

No. 34. "Mathematical Examinations at Oxford." By Mr. A. L. Dixon. Price 6*d.*

(London: Wyman and Sons, Lt Edinburgh: Oliver and Boyd; Dublin; E. Ponsonby, Ltd.)

Even Chrystal blundered; he is the only blunderer whose name is given by Mr. Barnard. Chrystal's was the last and greatest attempt to do for algebra what Euclid attempted for geometry, to build up the whole structure on a few axioms the truth of which was obvious. As the result of his attempt Chrystal learned (and was always ready to admit) how impossible of attainment this ideal is, a conclusion which is to-day becoming generally accepted. In the future, instead of trying to build mathematics up on axioms which are absolutely fundamental and by reasoning which only a genius is fit to grasp, we shall use as the foundation properties which are intelligible to every boy, we shall assume the truth of these whether obvious or not, and upon these we shall build the superstructure. The question of the soundness of the foundation is not a question for schoolboys, it is not even a question for the average university student, it is a question of metaphysics to be dealt with by the mathematical philosopher.

No. 30 is an account by Mr. L. M. Jones of the work in a municipal secondary school. The course is good, and ends with the calculus. It includes here and there an item on the value of which all would not agree, *e.g.* stocks and present value, solution of a quadratic by guessing factors, and the use of the straight line graph as introduction to graphs and the calculus. A sound opinion of Mr. Jones's, which one would like to see more widely adopted, is that the time spent in arithmetic on contracted methods is out of proportion to its value to the pupil, it being quicker and surer in most natural questions to use all the figures given than to contract.

In No. 32 Mr. Garstang attempts to pile up a load of wickedness on the Board of Education. He charges Circular 711 with loose reasoning in the matter of parallels, and quotes many authorities to show that a rigorous development cannot be based on the method of direction. But the withers of the Board are unwrung. It is the second and third stages of the Circular which deal with the systematic development of geometry; the first stage, containing the passage which displeases Mr. Garstang, is not concerned with rigorous development, but with the preliminary acquisition of the concepts of the subject.

At Oundle (paper No. 33) the data for practical mathematics are supplied from "the school shops, testing-rooms, and fields." This is admirable, and the boys show a keenness about the results because of their contact with reality, a keenness much greater than is aroused by questions which are only of academic interest to the pupils, however practical and important they may be for men or for other boys. A difficult problem for schools less fortunately situated than Oundle is the invention of laboratory questions which have real interest and importance for the boys to whom they are set.

No. 19 is a clear exposition by Prof. Gibson of mathematics in Scotch schools, which must have been of great value to members of the congress who were investigating such matters.

Preparatory Schools.

Paper No. 29 contains a pleasing sign of the times in the cooperation of public and preparatory schoolmasters. In former years a preparatory school had to prepare boys for a great variety of scholarship examinations, and a public school to continue the education of boys taught on a great variety of plans. To obviate the consequent difficulties, representatives of the Headmasters' Conference and the Association of Preparatory Schools have drawn up a syllabus for a boy's education in mathematics from nine to sixteen. This syllabus is now pretty widely used; it also bears witness to the advance made in recent years in the teaching of the subject.

Training of Teachers.

In No. 27 Dr. Nunn discusses the training of teachers of mathematics. Perhaps the most interesting part of his paper is his excellent syllabus of mathematical studies. The first part of the syllabus is compulsory, and includes numerical trigonometry and the ideas of the calculus. It is arranged with the object of giving a clear consciousness of mathematical conceptions. The logical proofs of these conceptions belongs to the second part, which is optional. The introduction to the calculus is made on historical lines, on which lines it is interesting to note that integration preceded differentiation.

One would like to see logarithms also follow the historical order, and introduced in Napier's way, without any consideration of indices. Dr. Nunn's method compels the treatment of negative and practical indices in part i., for which they are too difficult. But it is perhaps ungenerous to criticise a detail in a scheme drawn on such broad and statesmanlike lines.

Technical Institutions.

Nos. 24 and 26.—Most teachers of mathematics have their pupils at their mercy. In evening technical institutions we meet a new type, the youth who must be persuaded to come in. It is interesting and important that while mathematics treated in an abstract way deters him, the subject treated in connection with (and arising out of) concrete problems related to the boy's work not only persuades him to come in, but often gives him such an interest that he goes on with the abstract study.

Mr. Abbott also contributes the valuable suggestion that each locality should have an advisory committee composed of teachers of elementary schools, evening continuation schools, secondary schools, and technical schools, for the coordination of the work of these schools in regard to the preliminary training of technical students.

Dr. Sumpner and Mr. Abbott agree in the statement that students who come from elementary schools require much training in accuracy. There is clearly still room for reform in the mathematical teaching of these schools, when it is still necessary to recommend the abandonment of "discount, stocks and shares, H.C.F. and L.C.M., &c."

Universities.

In Nos. 21, 23, 25, 28, 31, 34, we have the views of the universities. Various changes are advocated, a reduction of the degree of analytical skill now required, an extension of the range of mathematical studies, closer connection with other subjects, more regard for after-careers, encouragement of original research. Recent reforms in school mathematics sometimes meet with approval, sometimes with disapproval. Oxford and Cambridge are working, in their examination regulations, towards a greater range and less analytical skill; Cambridge also towards meeting the needs of students of physics and engineering.

Prof. Bryan deplores the indifference of the practical man to the value of mathematics. Of this indifference there is no doubt, or of the fact that the practical man frequently meets a problem in which the mathematician could help him. The engineer has an outfit of mathematical tools sufficient for his

ordinary needs, but at times he meets a problem for which his tools are useless. He may then spend thousands of pounds on the determination of some point which the mathematician could have settled for a five-pound note. Instead of collaborating, the practical man and the mathematician scorn one another with an equal scorn, and indulge in pin-pricks when they happen to meet. It seems to us that it is for the mathematicians, who are seeking admission into the practical man's sphere, to hold out the olive branch, to go to him and say :—"Yes, we have often given you reason for thinking us fools. But we think we can really help you this time. Only let us try; if we fail, you are no worse off than before."

Education of Girls and Women.

No. 18 contains three papers by Miss Gwatkin, Miss Burstall, and Mrs. Sidgwick. Miss Gwatkin gives an effective statement of the advantages to be gained by a girl from the study of mathematics. We fear, however, that these advantages can only be attained by exceptional girls, and that for the average girl it is an attempt to turn a good girl into an inferior boy, to implant masculine virtues in place of developing the feminine ones. We could wish that Miss Gwatkin had supplemented her statement by an estimate of the relative advantages to the girl of mathematics and of possible alternative studies.

In the same paper Miss Burstall shows, in a historical sketch, the chance wind by which mathematics was introduced as a necessary element in the secondary education of girls, and then proceeds to inquire how far it is appropriate there. She is in general agreement with the present tendency to give an occupational turn to school studies, and points out how little connection mathematics has with the life of the bulk of women.

Miss Burstall divides girls into three classes. At one end of the scale is the small number with a real taste for mathematics. For these the subject is an admirable training, provided the danger of "narrowness, hardness, ossification," is avoided by requiring a concurrent training in English literature or some other literary subject.

At the other end of the scale come a number of girls who cannot do mathematics at all, or only with an enormous expenditure of energy. The teaching of these she compares to the laboratory manufacture of diamonds, the cost of production being quite out of proportion to the value of the resulting article.

Between these two extremes lie the bulk of the girls. For them mathematical training has value, but the same attainment must not be expected of them as of boys. The importance of other subjects and the girl's total energy-supply have to be considered. They should study mathematics for two or three years and get what value they can from the study, but the assessment of results by examination should not be forced on every girl. In school-leaving and college-admission examinations the necessary guarantee of austere intellectual effort can be secured by making Latin or an appropriate treatment of Harmony alternative with mathematics.

In a short and eloquent paper on university mathematics for women, Mrs. Sidgwick maintains that "there is no need to consider the case of women separately from that of men," and that while "in planning a scheme of general education regard must be had to the probable future work of the learners, a subject which is studied not for its own sake, but because it is useful for something else, is almost always degraded in the process, and loses much of its educational value." DAVID BEVERIDGE MAIR.

THE RUSTING OF IRON.[1]

IN the October issue of the Chemical Society's Journal, Mr. Bertram Lambert describes a second series of experiments on the rusting of iron. In these experiments it is shown by spectroscopic examination that carbon dioxide was actually present under the conditions used previously. Elaborate care was therefore taken to remove this, by heating as much as possible of the apparatus, whilst maintaining a high vacuum, and (during some of the successive heatings) cooling an attached tube in liquid air. The spectroscopic indications of carbon dioxide disappeared after the first of eight successive heatings, but no change was noticed in the readiness with which commercial iron rusted in the apparatus when purified oxygen and purified water were admitted. The author maintains, therefore, that these substances are capable of bringing about rusting in the absence of any trace of carbonic or other acid. The contrast between these results and those observed by Moody and by Friend is attributed to "passivity" induced in the metal in the one case by treatment with chromic acid (as suggested by Tilden), and in the other case by treatment with caustic soda (as suggested recently by Dunstan and Hill). This passivity must evidently be supposed to be permanent during many months of contact with air and water, but to be destroyed immediately by the merest trace of carbonic acid or by contact with glass.

An interesting account is given of the properties of pure iron as prepared by the methods previously described by the author, in which ferric nitrate is obtained so perfectly free from manganese that it no longer shows the violet colour which usually characterises the salt, and is then decomposed in iridium vessels, so as to avoid all risk of contamination with platinum. The metal so prepared is permanently resistant to rusting, even in contact with common air and common water. It does not dissolve in cold dilute sulphuric and nitric acids, but dissolves readily when the acids are heated. Hydrochloric acid dissolves the metal even in the cold. A similar contrast is noticed in the behaviour of the salts; the metal does not rust when exposed to air in presence of sodium, potassium, or ammonium sulphate or nitrate, but undergoes corrosion in a few hours when transferred to a normal solution of one of the chlorides. Again, pure iron will withstand the action of a saturated solution of copper sulphate or copper nitrate at the ordinary temperature for an indefinite time, without losing any of its lustre and without any perceptible trace of copper being deposited; but if a concentrated solution of copper chloride is used, the iron becomes coated with copper immediately it is put into the solution, and, within a few minutes, the iron all disappears, and only finely divided copper remains. The behaviour of the pure metal is here very similar to that of commercial aluminium.

The resistance of the purified metal to corrosion and to dissolution is probably due to the homogeneity of its surface, since if this is destroyed by pressing the metal with an agate pestle in an agate mortar the metal begins to corrode in less than an hour, rust being deposited on the unpressed parts of the metal whilst the pressed parts remain bright. In the same way copper is deposited on the iron if it is pressed in an agate mortar before being put into a solution of copper sulphate, or if it is pressed with a quartz rod while under the copper sulphate solution.

As a rule iron which will not rust will not deposit copper from the sulphate, and conversely; but in one

[1] See NATURE, 1911, vol. lxxxvi., p. 25.

case an interesting exception was observed. A piece of iron which had not rusted on long exposure to the action of air and water was placed in a strong solution of copper nitrate; after some time beautiful crystals of copper were deposited on parts of the iron, whilst other parts remained quite unaffected.

SOUTHERN HEMISPHERE SEASONAL CORRELATIONS.

THE first of a proposed series of articles on this important subject by Mr. R. C. Mossman, of the Argentine Meteorological Office, appears in *Symons's Meteorological Magazine* for February. Notwithstanding the great labour involved in this kind of research, it has received increasing attention from leading meteorologists during recent years. Mr. Mossman has collected a large mass of material relating to the climate of South America, which is now available for testing whether the sequences of weather in that continent "show as pronounced resemblances or contrasts, when compared with data from other regions, as do those in the northern hemisphere."

The inquiry now in question refers to the relation between the Nile flood and the winter rainfall of Santiago (Chile). The data used for the Nile floods are the percentage values for the years 1869–1906, published by Captain Lyons in "Rains of the Nile," 1906, and, for rainfall, the percentage values at Santiago for May–August of the same years. When plotted on a diagram, it is seen that, on the whole, there is a strongly pronounced opposition between the two sets of values. The author points out that the winter rainfall of Santiago, in common with other stations between 32° and 39° S., varies with the position of the South Pacific high-pressure area.

The Chilean Meteorological Office has recently supplied a complete set of instruments to Juan Fernandez, and the island is in radiographic communication with the mainland. This, with observations from a new station on Easter Island (27° S., 109° W.), should, Mr. Mossman thinks, afford useful information regarding the seasonal relations of the South Atlantic and South Pacific anticyclonic belts, and later on, when these data are compared with those at St. Helena, there is little doubt that the chain linking up the rainfall of Abyssinia with the Antarctic circulation will be complete. Captain Lyons has shown that the height of the Nile flood is dependent on the June to September rainfall in Abyssinia.

SOME METHODS OF MAGNIFYING FEEBLE SIGNALLING CURRENTS.[1]

TELEGRAPHY over long submarine cables is continually on the increase, and I think it may be brought forward as a fairly accurate statement that the number of messages sent doubles itself every ten years. It is therefore important that, besides the increase in the number of the cables laid down each year, means should be devised to increase the carrying power.

The instruments which I have invented and am about to describe were designed primarily for cable work, but they are equally applicable to recording many other kinds of signalling impulses.

For good reasons, recording by photographic means is objected to by nearly every telegraphist. If the photographic method were permissible, great advances in speed would be available, but it is important that the record should be of a simple, cheap, and immediate nature.

Lord Kelvin invented the siphon recorder in 1867—that is, about forty-five years ago; he designed it so carefully that no improvement in its sensitiveness has been brought about until now.

Short Siphon Recorder.

In siphon recorders of the moving-coil type what has to be done consists of—

(1) Overcoming the inertia of the coil and siphon.
(2) Overcoming the back E.M.F. of the coil.
(3) Overcoming the control of the suspensions.
(4) Overcoming the friction of air, suspensions, and inking.

As the siphon has to return to zero in a certain time after the current in the coil ceases, it is necessary for the coil and siphon to have a definite frequency of oscillation depending on the speed of the signals. For submarine telegraphy this frequency lies between about 3 and 10 per second, and is adjusted by varying the control on the coil. As the control necessary to give a certain natural period to the moving system is proportional to its moment of inertia, it follows that by reducing this inertia we reduce the forces required both to accelerate the coil and to overcome the control.

The ordinary siphon recorder employed is a siphon tube about $2\frac{1}{2}$ in. long and from 8 to 12 mils in

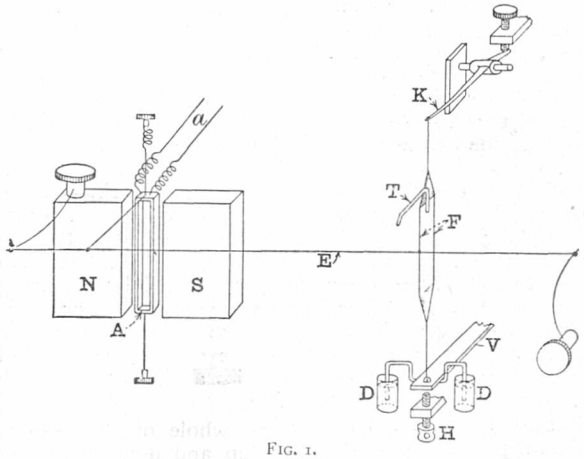

FIG. 1.

diameter. The moving coil consists of 500 turns of 2-mil wire at a mean radius of $\frac{3}{8}$ in. The coil and siphon are mounted on separate axes and are connected by silk fibres so that the angular movement of the siphon is about two to three times that of the coil. By reducing the length of the siphon to $\frac{1}{2}$ in. and substituting a narrower coil it is possible greatly to increase the sensitiveness of the recorder.

In order to make the inertia effects of the moving system a minimum, it is advisable to make them equal for the coil and the siphon. Even a narrow coil of 300 turns has about 100 times more inertia than the siphon, so that it is necessary to move the siphon through $\sqrt{100}$ times the angle moved by the coil.

By reducing the number of turns on the coil and increasing the field it is possible to reduce the natural period for a given sensitiveness and back E.M.F., but as the mass of the mountings and insulation of the coil only decrease slightly as the turns are reduced the gain is not very marked. In practice it is inadvisable to reduce the turns on the coil below 50 or 100 turns, as with lower values the power required to overcome the friction of the

[1] Discourse delivered at the Eighth Exhibition of Apparatus, held by the Physical Society on December 17, 1912, by Mr. S. G. Brown.

air and inking becomes too limited. This precludes the possibility of attaching the siphon directly to a coil of a few turns, and means of magnifying the motion of the coil and transmitting it to the siphon have to be used. In this instrument (Fig. 1) it is accomplished by means of a fine fibre, E, which is kept in tension by flat springs at each end. The fibre is attached to an arm carried by the moving coil A, and to a vertical fibre, F, on the siphon suspension.

The siphon is carried on an aluminium carrier to which a single central fibre is attached at the top and two parallel fibres, FF, 0·2 in. apart below. One leg of the siphon (Fig. 2) lies on the axis of the suspension and dips into a small opening in a pipe extending from the ink-pot. This arm goes in between the two vertical fibres, and as the opening in which the siphon dips is only a small one, the ink level remains practically constant, whether the reservoir is full or not. The siphon turns round on the axis in which the leg lies, and this makes the drag between the moving siphon and the ink very much less than if the siphon cut across the surface of the ink.

In order to produce an ink line on the paper without introducing friction, the siphon must not touch the paper even momentarily, and arrangements have been made to jerk the ink in fine drops on to the paper. To accomplish this the whole of the siphon suspension is vibrated rapidly up and down between the springs V and K by means of the spring V, which is attached to the vibrator. As the spring V is very weak in comparison with the reed, the vibrations of the latter are not affected by the movements of the spring. To impart a jerk to the siphon a stop, H, is fixed directly under the axis of suspensions, and two little dash-pots, DD, on either side prevent the spring bouncing on the stop.

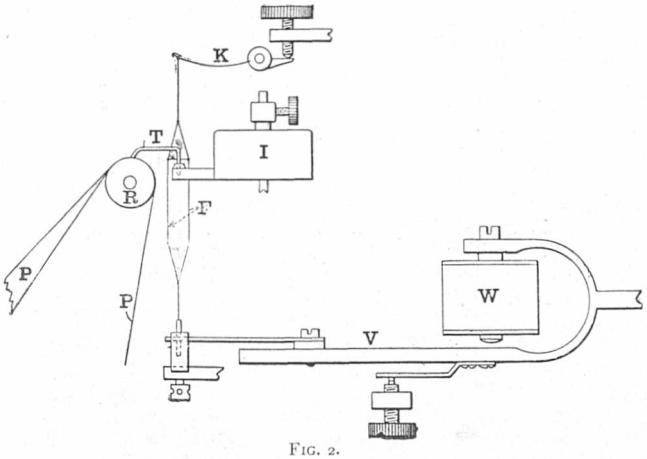

FIG. 2.

The working end of the siphon is ground flat, and an aniline dye with a small proportion of methylated spirit or ordinary red ink is used for recording on the paper. In this way a fine line of very closely spaced dots can be obtained without introducing any appreciable drag on the siphon.

For signalling purposes, the distortion due to the radius of the siphon being only $\frac{1}{2}$ in. is not at all troublesome as the velocity of the paper moving round the wheel R masks this.

When the instrument is adjusted to have a natural frequency of 10·5 per second, with a 300-ohm 300-turn coil, a current of 50 microamperes gives a full-sized signal corresponding to a deflection of 0·1 in. on the paper. Under these conditions the back E.M.F. of the coil is only about one-quarter to one-fifth of that of the ordinary recorder coil.

Trials with this instrument have shown an increase of speed of 30 per cent. on the largest Atlantic cables.

Thermoelectric Magnifying Relay.

In this instrument (Fig. 3) the power in the relay circuit is generated by means of five thermo-junctions at different temperatures. The heat is supplied by two little flames, CC, and a very light thermopile, B, is suspended so as to swing in and out of the flames, and is coupled to a moving coil through which the received currents pass.

The thermopiles consist of alternate junctions of platinum and platinum+20 per cent. iridium, wires being used of 1 mil diameter. The joints are made by twisting the ends of the two wires together and holding the junctions in a Bunsen flame for a short time. In this way a perfectly good and permanent joint is ensured. The wires are melted on to a fine glass tube about 10 mils in diameter, and one connection is brought down inside the tube to the first junction and the other connection comes along the outside of the tube.

For moving the thermopile in the flames similar arrangements to those just described for the siphon recorder are employed. Under the saddle which carries the thermopile the two silk fibres are stretched, and on to one of these the cross fibre which transmits the movements of the coil to the thermopile is attached. The top and bottom suspensions are of fine phosphor bronze wire and serve as leading-in wires to the thermopile.

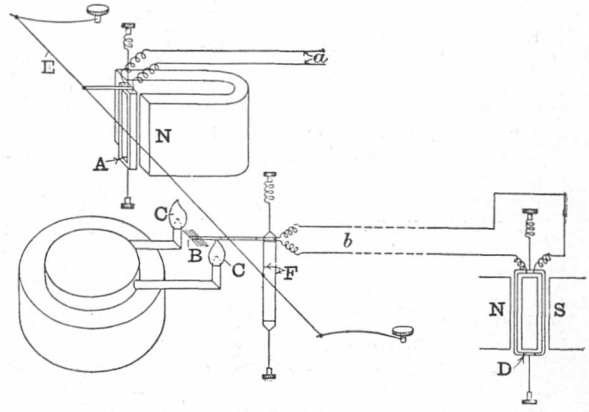

FIG. 3.

To supply the heat two little flames are fed by two or three strands of cotton wick with alcohol or methylated spirit. If the wick just protrudes above the opening a small steady flame is produced, and the lamp is provided with adjustments to vary the distance between the flames and the position of both flames relative to the thermopiles.

Instead of burning directly on the lamp wicks, a simple vapour burner can be fitted which will give good results even with very impure spirit. This consists of a brass cap which is kept hot by a copper wire attached to it at one end, and is heated at the other end by the flame. By altering the amount of wire in the flame the size can be varied.

An alternative arrangement which gives greater sensitiveness and enables heavier thermopiles to be used is to fix the thermopiles and vary the flames by means of a valve or shutter actuated by the coil movements.

As the thermopile current depends on the difference of temperature between the junctions a certain time is required to heat the wires. It is found that for cable work, where the frequency seldom exceeds

10 per second, the lag is inappreciable, but for considerably faster movements it becomes important.

In duplex working when the sending current has to be balanced so as not to affect the receiver, quick, "jarry" movements are very difficult to eliminate, but the lag in the thermo instrument reduces these movements very considerably and is a valuable property.

When the thermopile is in its central position and no current is flowing both junctions are at a dull red heat, and when fully deflected one junction becomes bright red and the opposite one is black or very faintly red. In intermediate positions the current generated by the thermopile is nearly proportional to the deflection.

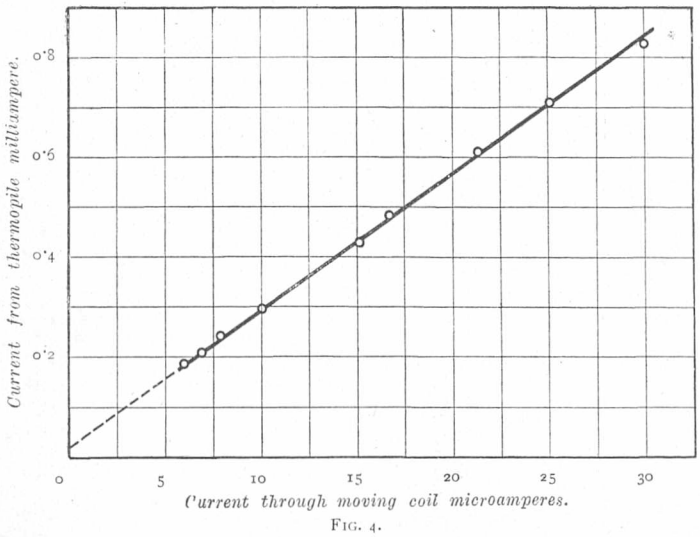

FIG. 4.

The curve (Fig. 4) was taken from a thermopile with seven junctions on each side. When the thermopile was deflected 0·075″ the current it sent through a resistance of 42 ohms (equal to its own resistance) was 0·81 milliampere. With the natural period of the coil equal to 8·7 per second and a 480-ohm 480-turn coil, a current of 0·03 milliampere through the coil gave a current of 0·81 milliampere from the pile through an external resistance of 42 ohms. For slowly changing currents this corresponds to a magnification of power of about twenty-seven times, and, of course, this can be greatly increased by reducing the period of the coil. For quickly changing movements the power magnification is not so great, owing to the back E.M.F. of the coil.

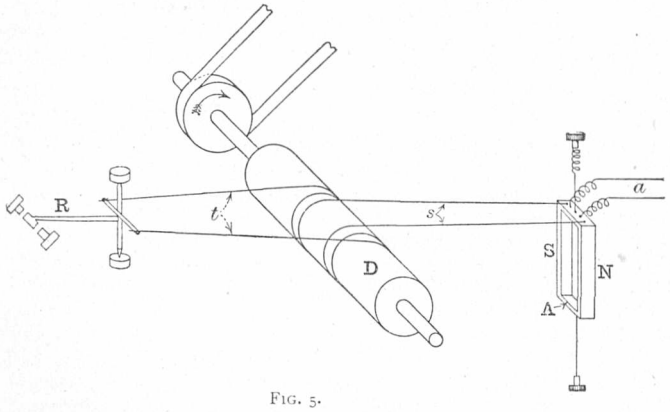

FIG. 5.

Trials of this instrument on an Atlantic cable have shown an increase in speed of about 40 per cent.

Mechanical Relay.

The instrument just described is a magnifying relay—that is to say, it multiplies the impulses received in exact proportion to their strength. This form of relay is quite distinct from an ordinary make-and-break relay, which delivers a constant current for any impulse over a certain strength. For very many purposes it is essential that received impulses should be magnified without altering their shape, and this can only be done by an instrument with a constant magnifying power.

That this is the case in the thermo relay is shown by the diagram (Fig. 4), where the current supplied to the coil and the current delivered by the thermo-junctions are plotted. Within the range of the instrument the points lie on a straight line and represent, in this case, a constant magnification in current of about twenty-seven times.

This property I will now illustrate in an entirely mechanical relay in which movements operated by very small forces are largely increased in strength without affecting their motion. The relay consists in principle of a rotating spindle around which are wound one or more turns of a flexible cord. The spindle is revolving in such a direction as to pull away from the magnified forces and towards the small forces that control the movement. Suppose a heavy weight has to be raised by a force of one-tenth of the amount, it will obviously be necessary to supply 90 per cent. additional energy, and this is supplied by the motor driving the spindle. The magnification of force and energy depends on the number of turns which the cord makes round the spindle and follows a compound interest law.

In the model shown it will be seen that a large magnification of power can be easily obtained by very simple means. Thus I can move this 14 lb. weight rapidly up and down by pulling upon this silk fibre.

Fig. 5 shows an application of the principle to cable work, in which the small forces operating the coil A are intensified sufficiently to work the coarse relay arm R. The spindle rotates away from the relay arm R and towards the coil, and produces a much greater tension in the fibres *t* than in *s*. When the coil swings on its axis the tension is increased in one of the fibres and diminished in the other, and a similar change in a magnified degree takes place in the fibres *t*.

By using means of this sort it is possible to work an ordinary siphon direct writer which normally requires some 3 milliamperes by a current of 10 microamperes.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

A SUMMER School in Geography will be held at the University College of Wales, Aberystwyth, on July 28–August 16. Among the subjects included in the scheme of work are:—Human geography, Prof. H. J. Fleure; climatology and trade routes, W. E. Whitehouse; land forms and natural regions, E. S. Price; field classes and excursions.

THE Department of Agriculture and Technical Instruction for Ireland has now published particulars of the summer courses for teachers it has arranged to hold in July and August next. With few exceptions the courses will be held in Dublin. In July teachers will have the opportunity of selecting their study from a wide variety of subjects of experimental science and technology. In August, practical mathematics, rural science, and a number of domestic arts will be taught. These courses are open only to persons who are over twenty years of age, and, except in the case of the courses in rural science (including school gardening) and drawing and modelling, only to teachers who are engaged (*a*) by local committees of technical instruction; or (*b*) in schools receiving grants either directly from the department or under the provisions of an approved local scheme of technical instruction. Application to attend the courses must be made before April 15.

THE Education Committee of the West Riding County Council proposes to hold at the Training College, Bingley, in August next, a vacation course for teachers in secondary, technical, elementary, and other schools, beginning on August 5. The course will not be limited to West Riding teachers, but will be open to all on payment of the fees. The aim of the course is to stimulate teachers and to give them opportunities of studying new methods of teaching the various subjects rather than to give specific instruction in the subjects themselves. The subjects to be dealt with cover most branches of the curriculum, and include the following:—The teaching of practical arithmetic, Mr. J. R. Deeley; the teaching of handwork, Miss K. Steel; the teaching of domestic subjects, Miss G. E. Irons; physiology, Miss F. E. Relf; the teaching of experimental science, Prof. Arthur Smithells, F.R.S., and Mr. H. Calam; and nature-study, Miss Mary Simpson.

IN his report for the academic year ending June 30 last, a copy of which has reached us, President Ira Remsen, of Johns Hopkins University, refers to the inauguration of a school of technology in the University. The creation of a new department of the University has been made possible by an Act of the Legislature of Maryland, in its session of 1912. The sum of 120,000*l.* was granted for the construction and equipment of buildings for a school of advanced technology. A further continuing annual grant of 10,000*l.* was also provided for maintenance. The provisions of the Act include the granting of 129 free scholarships to residents of the State. These scholarships are apportioned to the various legislative districts, to seven colleges in the State, and six may be awarded at large. Among the numerous public lectures given in the University during the year, we notice a course of eight on solar and terrestrial physics, by Prof. A. Schuster, one by Prof. W. Paszkowski, of the University of Berlin, on the organisation and work of that institution, and four by Prof. W. L. Johannsen, of the University of Copenhagen, on heredity and variation.

LORD HALDANE gave an address on the problem of national education at the conference of the National Union of Teachers on Tuesday, March 25. He stated that he could not describe the details of the scheme proposed by the Government, but he could give his own views. In the course of his remarks he said:—"If we do not keep abreast in the training of the national mind with those other countries which are organising their education systems, and which in many respects are our superiors, it is inevitable that in these days, when science and knowledge are the conditions of all success, industrial and generally, we shall fall behind in the race. It is a question of national safety, and nothing else, with which we are dealing. I am sometimes very much concerned about our industries when I think of the backwardness of our educational system, but man does not live by bread alone, and we shall not get even a good technical education system unless we put it on a broad foundation of national education. The State has a deep and direct interest in seeing that its people are educated, just as it has in seeing that they are healthy. A national system must take cognisance of all the means by which education is provided in a country like this. The highest means, the lowest means, the university, the secondary and the elementary school—they must all be fitted into their place in one system. Ten years ago there were only six teaching universities, but since then five more have been established. Putting outside Oxford and Cambridge, the number of students working in the day time has doubled in the last ten years. The number of degrees obtained by students in England and Wales in 1911 is more than twice the number obtained in 1901. There are things which cannot be secured outside the atmosphere of the university. I can never admit that an external student is the same as an internal student. The internal student has matured his mind in the university atmosphere. The external student is working hard, but only for the external examination, and some people with much less aptitude than their neighbours in what is best in the realities of education have much greater aptitude in passing examinations. Therefore the external examination is not a real test of learning. The only real test of learning on which I should like to give a degree exclusively is the record of the student during his time at the university."

SOCIETIES AND ACADEMIES.

LONDON.

Geological Society, March 5.—Dr. Aubrey Strahan, F.R.S., president, in the chair.—S. S. **Buckman**: The "Kelloway Rock" of Scarborough. The author has studied the types of ammonites from the Kelloway Rock described by Leckenby, preserved in the Sedgwick Museum, Cambridge, and a series of Yorkshire Kelloway-Rock ammonites from the Museum of Practical Geology, London. He has grouped these ammonites according to their different matrices, and finds that they indicate several different zones. These zones he arranges in sequence, and suggests how they may be compared with the sections of Kelloway Rock of Scarborough given by Leckenby and by Fox-Strangways. The exact order of the zones is, in one or two cases, not considered to be proved, but the paper is offered with the idea of indicating where further work is required.—L. F. **Spath**: Jurassic ammonites from Jebel Zaghuan (Tunis). Jebel Zaghuan, the best-known and most conspicuous, though not the highest, mountain of the Tunisian Atlas, is built up largely of massive bluish-grey limestones of confused stratification which have been referred to the Middle Lias on the evidence of badly preserved belemnites and Terebratulæ, notably "*Pygope*" *aspasia*, *Columna* sp. Middle Liassic (Domerian) ammonites are now recorded for the first time. A new classification of the Domerian genera of the family Hildoceratidæ, to which the fossils from Jebel Zaghuan belong, is proposed. Moreover, the ammonites collected by the author afford sufficient evidence of the presence of the zone of *Reineckia anceps*, which occurs in Algeria, but had been supposed absent in Tunis, together with the other beds intervening between the Middle Lias and the Corallian.

CAMBRIDGE.

Philosophical Society, February 24.—Prof. Pope, vice-president, in the chair.—Prof. **Pope** and J. **Read**: The ten stereoisomeric tetrahydroquinaldinomethylene-camphors.—J. E. **Purvis** and A. E. **Rayner**: The chemical and bacterial condition of the Cam above and below the sewage effluent outfall. The river was investigated at various points extending from 100 ft. above the outfall and at 8 ft. from the outfall, and at $\frac{1}{4}$ of a mile, $\frac{1}{2}$ a mile, $\frac{3}{4}$ of a mile, $1\frac{1}{2}$ miles, 2 miles, $2\frac{1}{2}$ miles, 3 miles, and 4 miles below the outfall. Chemically, the river purifies itself moderately well from the contaminating effluent, for at about three-quarters of a mile below the effluent, the albuminoid ammonia and the oxygen absorbed figures were lower than at 100 ft. above the effluent outfall. Bacterially, the dangerous pollution, as indicated by *B. coli*, is well marked at between three and four miles below the outfall. The potential danger of such contamination is in the direction of cattle quenching their thirst, of bathers, .and of watercress.—F. E. E **Lamplough** and Miss A. M. **Hill**: Some experiments on the slow combustion of coal dust.—F. R. **Ennos**: The oxidation of ferrous salts. Air or oxygen was bubbled through ferrous salt solutions and the rate of oxidation measured by withdrawing portions at known intervals and titrating with $KMnO_4$ or $K_2Cr_2O_7$. For the chloride, sulphate, and acetate the rates are approximately as 1 : 10 : 100, the reaction in the case of the sulphate being proportional to the square of the ferrous salt concentration, and to the partial pressure of the oxygen. The oxidation seems to depend on the non-ionised part of the ferrous salt molecule.—W. H. **Mills** and Miss A. M. **Bain**: The optically active semicarbazone and benzoylphenylhydrazone of *cyclo*hexanone-4-carboxylic acid.—Dr. G. F. C. **Searle**: Experiments illustrating "flare spots" in photography. When light from a point S falls on a simple thin lens of focal length f, most of it passes through the lens and forms an image of S. But some of the light suffers two reflexions within the lens, and this light gives rise to a second image of S of small intensity, the corresponding focal length being $(\mu-1)f/(3\mu-1)$, where μ is the refractive index. This image is called a "flare spot." When two lenses are used there are six flare-spot images of any object formed by twice reflected rays and with t lenses there are $t\ (2t-1)$ such images.—J. G. M. **Dunlop**: Effect of heating paraformaldehyde with a trace of sulphuric acid. The author finds that in the preparation of α-trioxymethylene (Pratesi, Gaz., xiv., 139), by heating paraformaldehyde (trioxymethylene) with a trace of concentrated sulphuric acid in a sealed tube for some hours at 115° C., a considerable amount of the formaldehyde is converted to methyl formate.

PARIS.

Academy of Sciences, March 10.—M. P. Appell in the chair.—The president announced the death of M. Alfred Picard.—C. **Guichard**: A particular class of Moutard's equations.—Paul **Sabatier** and M. **Murat**: The direct hydrogenation of the hydrocinnamic esters; preparation of β-*cyclo*hexylpropionic acid. The reaction is effected with an active nickel at a temperature of 170° to 185°. Four esters have been prepared, and also β-*cyclo*hexylpropionamide.—R. **Lépine** and M. **Boulud**: The secretion of the two kidneys compared. In the healthy dog one of the ureters generally furnishes less urine than the other; there are also differences in the composition of the urine.—Henri **Renan**: Results of the discussion of observations made by MM. Delporte and Viennet, to determine by wireless telegraphy the difference of longitude between the Royal Belgian Observatory and the Observatory of Paris. The observations extended from May 1 to August 2, 1912, and comprised twenty determinations by wireless telegraphy and nineteen by ordinary telegraphy. The mean error of a single observation was ±0·0245 sec. by wireless and ±0·0285 sec. by ordinary telegraphy.—J. **Clairin**: The invariants of the characteristics of partial differential equations of the second order with two independent variables.—Vasilesco **Karpen**: The flight of birds called hovering flight. A calculation showing that hovering flight is possible when the mean geometric acceleration of the wind reaches 30 cm. to 50 cm. per second.—J. de **Boissoudy**: The law of radiation of a black body and the quanta theory.—Albert **Turpain**: Extra-sensitive relays for wireless telegraphy. The relay dscribed has a sensibility of the order 0·01 microampere.—C. **Tissot**: The reciprocal influence of two neighbouring antennæ.—F. **Bodroux**: Some liquid mixtures particularly suitable for the observation of Christiansen's phenomenon. A suitable mixture is made by pouring 15 gr. of ethyl acetate and 10 gr. of water into 50 gr. of saturated sodium chloride solution.—E. **Rothé**: The reception of radio-telegrams by multiple antennæ with or without contact with the soil.—A. **Guyau**: An interferential oscillograph. The apparatus figured was designed to register photographically oscillations of the magnitude of those of a telephone membrane.—B. **Szilard**: A spiral electrometer.—Ch. **Fabry** and H. **Buisson**: The absorption of ultra-violet light by ozone, and the extremity of the solar spectrum. The authors' results, taken with those of Cornu on absorption by the atmosphere, are in accord with the hypothesis of the absorption of the ultra-violet rays by ozone in the atmosphere.—B. **Bianu**: The secondary radiation produced by the α rays.—Camille **Matignon**: Chemical equilibrium in the action of hydrochloric acid gas on zinc sulphate.—E. **Rengade** and N. **Costeanu**: The anhydrous monosulphides of the alkaline metals. The pure sulphides, Na_2S, K_2S, and Rb_2S, were obtained by allowing the vapour of sulphur to react upon the metal, with special precautions against the access of air. These sulphides are very easily oxidised; it is sufficient to touch one at a point with a hot glass rod for the mass to become incandescent and burn like tinder.—E. E. **Blaise**: The migration of chlorine in the chloroketones.—A. **Lassieur**: The catalytic hydrogenation of acetone. At temperatures between 200° and 300° C. hydrogen in presence of reduced nickel gives with acetone neither isopropyl alcohol nor pinacone, but methyl*iso*butylketone in large quantities, smaller amounts of valerone and other higher condensation products.—P. **Lebeau** and A. **Damiens**: The composition of coal gas. An application of the general method of analysing complex mixtures involving the use of very low temperatures recently described by the authors. The presence of ethane, propane, and butane was proved with certainty.—L. **Ravaz** and G. **Verge**: The germination of the winter spores of *Plasmopara viticola*.—L. **Blaringhem**: The phenomena of xenia in wheat.—C. L. **Gatin** and C. M. **Bret**: The varieties of *Elais guineensis*, of the Ivory Coast, and their parthenocarpic fruits.—Paul **Becquerel**: Vascular ontogeny of the plantule of the lupin and its consequences for certain theories of the classical anatomy.—Anna **Drzewina** and George **Bohn**: Anoxybiose and chemical polarity. An account of the effects of deprivation of oxygen on various species of invertebrates.—E. **Bataillon**: Demonstration of inoculation superposed on puncture in traumatic parthenogenesis.—Mlle. **Chevroton** and M. **Fauré-Fremiet**: A kinematographic study of the cytoplasmic phenomena of the division of the egg of Ascaris.—G. J. **Painvin**: The siphon of the Spirulæ.—H. **Vincent**: The action of polyvalent antityphoid vaccine in subjects in the incu-

bation stage of typhoid fever or infected in the course of immunisation. From experience gained in the typhoid epidemics cited it would appear that with this vaccine there is no negative phase, and there is no danger in vaccinating during epidemics.—MM. **Desgrez** and **Dorléans**: The influence of the amino group on the arterial pressure. A lowering of the blood pressure is produced by minimal doses of certain amino compounds, but an increase in the amount injected produces ultimately an increase in the arterial pressure.—J. **Houdas**: The presence of choline or allied bases in the saliva of the horse.—Em. **Bourquelot** and M. **Bridel**: The synthesis of the glucosides of alcohols with the aid of emulsin. β-Phenylethylglucoside and β-cinnamylglucoside.—Ph. **Négris**: The age of the cristallophyllian series of the Cyclades and the date of the foldings which have affected it.—F. **Dienert**: Study of the temperatures of subterranean water for public supply.—V. **Crémieu**: Seismographs giving directly the three components of an earthquake and slow variations from the vertical.

March 17.—M. P. Appell in the chair.—E. H. **Amagat**: Saturation curves and the law of corresponding states. The author concludes that the law of corresponding states is more rigorous than is usually admitted, and gives reasons for supposing that deviations from the law are probably due to experimental error.—A. **Müntz** and E. **Lainé**: The materials transported by the watercourses of the Alps and Pyrenees. The utilisation of mountain streams either for power or irrigation purposes requires an approximate knowledge of the amount of solid material brought down, as this material would tend to fill up more or less rapidly any storage reservoirs which might be constructed. A preliminary study has been made on eighteen rivers, and it has been found that the amounts of solid material brought down by alpine streams are so great that the construction of storage reservoirs will require very careful choice; the streams from the Pyrenees are much less troublesome in this respect.—M. **Gouy**: The theory of the gaseous photosphere.—D. **Eginitis**: The opacity of the sky and weakening of the solar radiation observed during the year 1912. The heliograph at Athens shows a progressive weakening in the solar radiation commencing April 7, 1912.—M. **Luizet** and J. **Guillaume**: Observation of the occultation of the Pleiades by the moon made on March 13, 1913, at the Observatory of Lyons.—Léon **Antonne**: Hypohermitian matrices.—Ch. **Muntz**: The solution of secular equations and integral equations.—Georges **Rémoundos**: Families of algebroid functions.—Farid Boulad **Bey**: The disjunction of the variables in equations representable by nomograms.—Th. De **Donder**: Hilbert's theorem of independence.—Carlo **Bourlet**: Apparatus for measuring the vibrations of solid bodies in motion. A description of an instrument for measuring the vibration of the wing of an aëroplane, based on the use of two manometric capsules.—Emile **Jouguet**: The propagation of deflagrations in gaseous mixtures.—Edouard **Guillaume**: The extension of the mechanical equations of Appell to the physics of continuous media. Application to the theory of electrons.—Kr. **Birkeland**: Hertzian oscillations produced by intermittent discharges starting from isolated spots of a kathode in a Crookes's tube.—Henri **Bénard**: The prismatic cleavage due to cellular vortices (starch, basalts, &c.).—Jean **Bielecki** and Victor **Henri**: The quantitative study of the absorption of the ultra-violet rays by acetone. In alcoholic solution and in the liquid state acetone possesses a single band in the ultra-violet; the absorption curve can be exactly represented by the formula of Ketteler, Helmholtz, Reiff, and Drude.—Mlle. E. **Feytis**: The magnetic properties of some solid hydrates of copper and chromium.—Daniel **Berthelot** and Henry **Gaudechon**: The decomposition of gaseous compounds by light. Hydrochloric acid is dissociated by the extreme ultra-violet, $\lambda<0{\cdot}2\mu$. Hydrobromic acid is more readily decomposed, and, in presence of mercury, the decomposition after eight hours is complete. Water vapour is decomposed by rays $\lambda<0{\cdot}2\mu$ to the extent of one-thousandth. Hydrogen sulphide and selenide are readily split up under the same conditions.—Mme. N. **Demassieux**: Study of the equilibrium between lead chloride and ammonium chloride in aqueous solution.—René **Dubrisay**: A new method of physico-chemical volumetric analysis.—A. **Wahl** and P. **Bagard**: Syntheses in the indigo series.—A. **Seyewetz**: The action of hydrochloric acid upon quinone sulphonic acid.—G. **Petit** and R. **Ancelin**: The influence of radio-activity upon germination. The experiments prove the stimulating influence of weak radio-activities on the plant cell.—L. **Moreau** and E. **Vinet**: The comparative effects of arsenic and lead in treatment of vines for the larvæ of Cochylis. Lead arsenate proved to be the most efficacious form of applying arsenic for the destruction of the larvæ of Cochylis.—D. **Keilin**: An intracellular fibrillary formation in the tunic of the salivary gland in the larva of Syrphinæ.—Raphael **Dubois**: The treatment of tuberculosis by marine micro-organisms. Cultures of a Micrococcus obtained from the pearl sac of *Pinna nobilis* or *P. squammata* were used to inoculate tuberculous guinea-pigs; eleven out of twelve survived.—Henri **Stassano**: The mode of action of the anti-coagulating substance of the plasma of propeptone.—Mlle. C. **Robert**: The antitoxin behaviour of calcium in the case of some nutritive salts in the culture of the pea and lupin in liquid media.—W. **Kopaczewski**: The dialysis of maltase.—M. **Deprat**: The Triassic strata in the region of the middle Black River (Tonkin).

CALCUTTA.

Asiatic Society of Bengal, February 5.—Dr. Malcolm **Burr**: Indian Dermaptera collected by Dr. A. D. Imms. A number of new localities for known species of earwigs are put on record and one new species is described.—Dr. W. A. K. **Christie**: The composition of the water of the Lake of Tiberias. The water of the Sea of Galilee is shown to differ widely from that of almost all lakes with an outlet, and to approximate more in composition to that accumulated in closed basins. The difference is due to the peculiar nature of the soluble constituents of the rocks of the neighbourhood, as shown by analyses of spring waters near the town of Tiberias.—Major J. **Stephenson**: Aquatic Oligochæta of the Lake of Tiberias. The collection obtained by Dr. Annandale from the edge of the Lake of Tiberias includes specimens of a number of species, representing several different families; but the majority are immature, and only two can be identified—a Helodrilus described as new, and *Criodrilus lacuum*, a common European species.

BOOKS RECEIVED.

Mysore Geological Department. Report of the Chief Inspector of Mines for the Year 1911–12, with Statistics for the Calendar Year 1911. Pp. 45+12 tables+81. (Bangalore: Government Press.) 2 rupees.

The Coleoptera of the British Islands. By Dr. W. W. Fowler and H. H. J. Donisthorpe. Vol vi. (Supplement.) Pp. xiii+351+3 plates. (London: Lovell Reeve and Co., Ltd.) 18*s*. net.

Handbuch der Morphologie der wirbellosen Tiere. Edited by A. Lang. Band 3, Lief. 1. Band 4, Lief. 2. (Jena: G. Fischer.) 5 marks each Lief.

Bericht über die Tätigkeit des Königlich Preussischen Meteorologischen Instituts im Jahre 1912. Pp. 53+172+3 plates. (Berlin: Behrend and Co.) 6 marks.

Bibliotheca Geographica. Band xvii. Jahrgang 1908. Pp. xvi+533. (Berlin: W. H. Kühl.)

Iowa Geological Survey. Vol. xxi. Annual Reports, 1910 and 1911, with Accompanying Papers Prepared in Cooperation with the U.S. Geological Survey. Pp. xvi+1214+xviii plates. (Des Moines: Iowa Geological Survey.)

Traité Complet d'Analyse chimique appliquée aux Essais Industriels. By Profs. J. Post and B. Neumann. Deux. Edition Française, Entièrement Refondue. By G. Chenu and M. Pellet. Tome Troisième. Second Fasc. Pp. 465–902+v. (Paris: A. Hermann et Fils.) 15 francs.

Traité de Chimie Minérale. By H. Erdmann. Translated by Prof. A. Corvisy. Tome Premier. Pp. iv+559. (Paris: A. Hermann et Fils.) 12 francs.

A New Philosophy: Henri Bergson. By E. Le Roy. Translated by V. Benson. Pp. x+235. (London: Williams and Norgate.) 5*s*. net.

Myths of the Modocs. By J. Curtin. Pp. xii+389. (London: Sampson Low and Co., Ltd.) 12*s*. 6*d*. net.

In the Lap of the Lammermoors. By W. M'Conachie. Pp. xii+315. (Edinburgh and London: W. Blackwood and Sons.) 5*s*. net.

The Belief in Immortality and the Worship of the Dead. By Prof. J. G. Frazer. Vol. i. Pp. xxi+495. (London: Macmillan and Co., Ltd.) 10*s*. net.

Das Miocän von Eggenburg. By Dr. F. X. Schaffer. (Abhandlungen der K.K. Geologischen Reichsanstalt. Band xxii. Heft 2.) Pp. 129–193+12 plates. (Vienna: k.k. Geologischen Reichsanstalt.) 16 kronen.

The Deciding Voice of the Monuments in Biblical Criticism. By Dr. M. G. Kyle. Pp. xviii+320. (London: S.P.C.K.) 4*s*. net.

Aus Süd-Brasilien. By Dr. W. Breitenbach. Pp. xvi+251. (Brackwede i.W.: Dr. W. Breitenbach.) 3 marks.

The Chemistry of Dyeing. By Dr. J. K. Wood. Pp. vii+80. (London: Gurney and Jackson.) 1*s*. 6*d*. net.

Volume and Surface Integrals Used in Physics. By J. G. Leathem. Second edition. Pp. iv+73. (Cambridge University Press.) 2*s*. 6*d*. net.

Machine Construction and Drawing. By A. E. Ingham. Pp. xii+143. (London: G. Routledge and Sons, Ltd.) 1*s*. 6*d*. net.

Vorträge über Deszendenztheorie gehalten an der Universität zu Freiburg im Breisgau. By Prof. A. Weissmann. Dritte Auflage. Erster Band und Zweiter Band. Pp. xiv+342+vii+354+3 plates. (Jena: G. Fischer.) 13 marks.

Die Palæobotanische Literatur. Edited by W. J. Longmans. Dritter Band. Die Erscheinungen der Jahre 1910 und 1911 und Nachträge für 1909. Pp. 569. (Jena: G. Fischer.) 26 marks.

DIARY OF SOCIETIES.

THURSDAY, MARCH 27.

CONCRETE INSTITUTE, at 7.30.—Props and Beams in Mines: Prof. S. M. Dixon.

MONDAY, MARCH 31.

INSTITUTE OF ACTUARIES, at 5.—The Estimated Age Distribution of the Indian Population, as Recorded at the Census of 1911, and the Estimated Rates of Mortality, Deduced from a Comparison of the Census Returns for 1901 and 1911: T. G. Ackland.

TUESDAY, APRIL 1.

ROYAL INSTITUTION, at 3.—Recent Discoveries of Early Man: Dr. A. S. Woodward.

RÖNTGEN SOCIETY, at 8.15.—The Physiological Principles of Internal Radium Therapy: Prof. Saubermann, Berlin.—The Radiographic Episcope, a New Instrument for the Utilisation of the Single X-Ray Print: Dr. Cotton.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Yield of Various Catchment-Areas in Scotland: W. C. Reid.—Measurement of the Flow of the River Derwent, Derbyshire: E. Sandeman.

WEDNESDAY, APRIL 2.

ENTOMOLOGICAL SOCIETY, at 8.

SOCIETY OF PUBLIC ANALYSTS, at 8.—The Moisture in some English, Colonial and Foreign Butters during 1910–1912, with a Note on the Mitchell-Walker Moisture Test: L. Gowing-Scopes.—Egyptian Butter and Semna: S. H. Trimen.—A Simple Test for Differentiating between Cocoa-Butter and "Green" Butters: C. Revis and E. Richards Bolton.—The Correct Way to Use Glycerine-Jelly in Mounting Microscopical Objects: L. W. Stansell.—A New Apparatus for Maintaining Constant Temperatures: F. H. Dupré and P. V. Dupré.

BRITISH ASTRONOMICAL ASSOCIATION, at 5.

THURSDAY, APRIL 3.

ROYAL INSTITUTION, at 3.—The Bridge into Life: Dr. E. Frankland Armstrong.

LINNEAN SOCIETY, at 8.—Some Forms of *Alchemilla vulgaris*: C. E. Salmon.—Report on H.M.S. *Sealark*, Calcarea: Prof. A. Dendy.—*Embia major*, sp. nov., from the Himalayas: Prof. A. D. Imms.—A Free-swimming Nauplioid Stage in Palinuris: Dr. J. D. F. Gilchrist.—The Classification of the Order Symphyla: R. S. Bagnall.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—*Further Discussion*: Some Effects of Superheating and Feed-water Heating on Locomotive Working: F. H. Trevithick and P. J. Cowan.

FRIDAY, APRIL 4.

ROYAL INSTITUTION, at 9.—The Spectroscope in Organic Chemistry: Dr. J. J. Dobbie.

GEOLOGISTS' ASSOCIATION, at 8.—The Geology of the Nottingham District: B. Smith.

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