THURSDAY, MARCH 5, 1903.

ELECTRICAL STIMULUS AND RESPONSE.

Response in the Living and Non-Living. By Jagadis Chunder Bose, M.A. (Cantab.), D.Sc. (Lond.). Pp. xix + 199; with illustrations. (London: Longmans, Green and Co., 1902.) Price 10*s.* 6*d.*

THE apparent aim of this book is to show that "living response in all its diverse manifestations is found to be only a repetition of responses seen in the inorganic" (p. 189). It is difficult to treat this conclusion seriously, and the difficulty is sensibly increased by the mental bewilderment which is experienced on reading such statements as the following :—

"From a confusion of 'dead' things with inanimate matter it has been tacitly assumed that inorganic substances, like dead animal tissues, must necessarily be irresponsive, or incapable of being excited by stimulus—an assumption which has been shown to be gratuitous" (p. 181).

The conclusion which we are compelled to draw from this quotation is that Prof. Bose does not regard dead things as inanimate matter, and if this be the case, it may seem superfluous to offer any extended criticism of those portions of the book which set forth the experimental grounds for such beliefs. It is, however, very desirable that discredit should not be thrown upon the use of fruitful methods of investigation well known to physiologists in consequence of the fallacious character of the author's conclusions; moreover, the experiments upon which he rests his case are set forth in a somewhat convincing manner, and the book may with the aid of copious illustrations achieve some popularity.

The experimental facts brought forward comprise, (1) some limited aspects of the changes occurring in muscles, nerves and plants when subjected to particular modes of stimulation, and (2) some electrolytic effects occurring when moist conductors are brought into contact with metallic surfaces and the latter are caused to vibrate. It is on the strength of a superficial resemblance between the electromotive changes observed in these two groups that the author makes his astounding generalisations. The phenomena of muscle and nerve brought forward are taken from various physiological works, and the particular response selected is that of the familiar excitatory electromotive change; it is, however, very inadequately treated, as no reference is made to the classical researches of Du Bois-Reymond, Hermann, Bernstein, Hering, Burdon Sanderson and others.

In consequence of the author's limited survey of the subject, he has fallen into an error of quite an elementary nature in his description of the muscular response. He appears to think that the superficial resemblance between the change of form which muscle undergoes in contraction and the swing of a galvanometer needle when deflected by the sum of the electrical currents present in tetanised muscle affords sufficient ground for the statement that "it is found that the electrical and mechanical records are practically identical" (p. 12). This identity can only refer to the time relations of the two classes of events, and it has been known for half a century that the electrical and mechanical responses do not run the same course. The results obtained by the physiological rheoscope, the repeating rheotome, the telephone and the capillary electrometer (all disregarded by the author) afford convincing proof that whereas the change of form during so-called tetanus is sustained by the fusion of the successive mechanical responses, the electrical disturbances are not so fused, but constitute a rhythmical series of distinct states. The time relations of the muscular twitch evoked by a single stimulus reveal the reason for this want of parallelism, since the electrical response has both culminated and subsided before the mechanical one has been completed. The author having thus disregarded the most fundamental characters of muscular and nervous responses, *i.e.* their time relations, it is clear that no sweeping generalisations involving these responses are justifiable.

In treating the vegetable tissues, the author has selected as a typical response an electrical change which occurs in portions of plants which have been subjected to sudden mechanical strain (torsion, &c.). The displacement caused by the strain is associated with a difference of electrical potential in the part primarily affected as compared with other parts situated in more remote, and thus less disturbed, regions. These electrical alterations are of considerable interest, and attention has been drawn to their existence by Waller, who has pointed out their local character. The local character of the electromotive effect has its counterpart in animal tissues, but it is not characteristic of those particular animal responses which are selected by the author for the purpose of comparison, since these are propagated from the seat of stimulation along the protoplasmic continuum of the muscle or the nerve fibres. Propagated effects of this type can be found in certain plant tissues—for instance, Dionæa—but the plant responses described by Prof. Bose do not include these. It follows, therefore, that such comparisons as the author is able to make do not warrant the sweeping statement that

"a complete parallelism may be held to have been established between plant response on the one hand and that of animal tissue on the other" (p. 80).

Some curious chapters in the book deal with a novel "response in metals." This was generally obtained by connecting a strip of metal (tin, platinum, &c.) with moist conductors, which in their turn were connected with a galvanometer through non-polarisable junctions; the sudden jar of a blow was the so-called stimulus, and the alterations caused by the shatter in the polarisation interfaces appear to constitute the so-called electrical response. The observations are brought forward by Prof. Bose, not so much for any intrinsic physical interest they may possess, as for the purpose of showing how far they are susceptible of modification under conditions which, in his opinion, also modify the electromotive phenomena of living tissues and thus of serving as a support for his speculations. The language employed in their description is often of a singular character; thus

we are told that "tin is practically indefatigable" (p. 118), that

'we may thus, by reducing or abolishing the excitability of one end by means of suitable chemical reagents (so-called method of injury) obtain response in metals" (p. 87),

and many other phrases borrowed from physiologists occur plentifully in the text. The use of such terminology appears in itself to indicate the unconscious bias of the author towards the conclusion he has in view.

In later chapters of the work, a series of apparent resemblances between the retinal currents described by physiologists and photoelectrolytic changes in sensitised metal plates leads the author to the amazing assertion that

"there is not a single phenomenon in the responses, normal and abnormal, of the retina which has not its counterpart in the sensitive cell constructed of inorganic material" (p. 169).

After this, we are incapable of being further surprised, even by the confident prediction that

"the parallelism will thus be found complete in every detail between the phenomena of response in the organic and inorganic" (p. 147).

We are all aware that living processes, apart from the evidence of our own consciousness, can only reveal themselves as physical and chemical changes; among these are the electromotive effects in living tissues which afford one aspect of those subtle and complex physico-chemical relationships comprised under the term metabolism. The play and nature of this metabolism constitute for most of us the fundamental mystery of life; but to Prof. Bose the living response presents "no element of mystery" (p. 189). Metabolism, with its phases of assimilation and dissimilation, has for him no significance, and he characterises all correlations of electromotive change with metabolic process as arbitrary and unnecessary assumptions (p. 126). Even the connection of fatigue in animal tissues with the dissimilation products of activity has, he says, long been seen to be an inadequate explanation. He admits that "the criterion by which vital response is differentiated is its abolition by the action of certain reagents" (p. 188), yet he declares that metals can be "transformed from a responsive to an irresponsive condition by the action of similar poisonous reagents" (p. 188). We are bewildered by this apparent inconsistency, and are thankful to reflect upon such statements as he does not make. Among these, the most consoling is that of the re-creation of a living tissue; it is clear that although the metallic combination may be turned backwards and forwards through responsive and irresponsive stages, there is no such retransformation of the living tissues when once these have become what Prof. Bose calls "dead things." This should give him pause in his prediction that the reader will find that parallelism *complete in every detail* which, upon the strength of specious and partial resemblances, he claims to have established between the behaviour of materials living and non-living. F. G.

THE LEAD ACCUMULATOR.

Secondary Batteries: their Theory, Construction, and Use. By E. J. Wade. Pp. ix+492. (London: The *Electrician* Printing and Publishing Co., Ltd.) Price 10*s.* 6*d.* net.

MR. SWINBURNE in his presidential address to the Institution of Electrical Engineers remarked that it was wonderful that we had the lead cell at all, seeing that we owed it to a chance observation of Planté. On a perusal of Mr. Wade's book it seems even more remarkable that the "chance observation of Planté" has been developed into so indispensable an adjunct of electrical engineering. It is usually the boast of the electrical engineer that his branch of engineering can lay claim to being an exact science in the truest sense. He is able to base on a solid foundation of theory the design of a 4000 H.P. alternator or a sensitive millivoltmeter, and feel confident that the result will be what he requires. He can work contentedly with these things, because he feels that he knows to what their behaviour under different conditions is due. But with the accumulator it is different. Probably nine electrical engineers out of ten do not know what is the cause of the E.M.F. given by the combination lead / sulphuric acid / lead peroxide, but imagine that, like Topsy, "it just growed." Still less would they be able to give any plausible explanation of the frequently erratic behaviour of accumulators. This is partly due to a narrow-minded contempt for chemistry, more or less inherent in the electrical engineer in his student days, and only regretted when the time for studying first principles is past. But the ignorance must be also partly ascribed to the unsatisfactory condition of the knowledge amongst experts in the subject.

These circumstances make Mr. Wade's book all the more welcome. The author has endeavoured to set forth all that is known concerning the storage battery, and great credit is due to him for the very thorough way in which he has carried out his task. After a brief introductory chapter, the author passes to the history of the lead cell; it is noteworthy that this chapter practically resolves itself into a history of the development of the "grid" or other support for the active material, so slight is the alteration that has been made from the chemical side since the time of Planté and Faure. The tenth and final chapter, in which are described all the leading makes of cells, whether of English, continental or American manufacture, is marked by the same characteristic.

The seventh, eighth and ninth chapters deal with the manufacture, testing and use of lead cells, and these will be found very instructive, especially by those interested in the commercial application of the storage battery. In the eighth chapter the author has attempted to define the lines on which lead cells should be designed; the result is not very satisfactory, but the fault does not lie with Mr. Wade. Until theory has shown the way, design must necessarily be carried out on empirical lines, and reliance must be placed on intuitive perception of what is good and what bad. In chapter iii. Mr. Wade discusses storage cells

other than lead, and though the attempts to find some satisfactory substitute for the lead cell have been many, the results have been in all cases disappointing; it remains to be seen whether Mr. Edison's iron / nickel-oxide combination will prove any more practical than its forerunners. As yet the trustworthy information concerning its behaviour and durability is too meagre for any prophecy as to its future to be made.

We have left the contents of chapters iv. and v. to the last, as these contain what to many will doubtless prove the most interesting part of the book. In chapter iv., on the properties and behaviour of lead cells, the electrical phenomena which a complete theory of the chemical reactions must explain are described, and in chapter v. the author deals with the theories which have been advanced. The information as to the electrical behaviour is full and comprehensive, and typical curves of charge and discharge under various conditions are given. These points have been very thoroughly studied both in commercial and in experimental cells, and it is perhaps surprising that their theoretical explanation has proved so difficult. Mr. Wade's views were expressed in his paper read before the Institution of Electrical Engineers three years ago, and they are here repeated. The cycle of changes taking place on discharge, reversal and recharge is explained as being due to changes in a complex lead molecule on the one hand, and a similarly complex lead-peroxide molecule on the other. Double sulphation results from the addition of (SO_4) groups one by one (with corresponding removal of O_2 on the peroxide plate), but the process does not go on until the active material has the composition $Pb_{12}(SO_4)_{12}$ (on the assumption of initial composition Pb_{12} and $Pb_{12}O_{24}$ respectively) on both plates. When the active materials have the compositions $Pb_{12}(SO_4)_8$ and $Pb_{12}O_8(SO_4)_8$ the plates are fully discharged. If the current be now kept flowing in the same direction reversal sets in with addition of O_2 at the negative, and its removal at the positive, and this goes on until $Pb_{12}O_8(SO_4)_8$ and $Pb_{12}(SO_4)_8$ are formed; continuing the current still in the same direction O_2 is added and (SO_4) removed at the (old) negative and (SO_4) removed at the (old) positive, until finally $Pb_{12}O_{24}$ and Pb_{12} are reformed, and the cell is fully charged, but with the plates reversed.

This explanation, it is true, helps to explain some of the obscure points in the behaviour of lead and lead peroxide in the accumulator, but it is questionable whether the weight of evidence in its favour is sufficient to justify the assumptions necessary, even though these may be to some extent supported by collateral evidence of a purely chemical nature. The truth of the matter seems to be that at present we cannot go much beyond the double sulphation theory originally put forward in these columns by Gladstone and Tribe. Progress is barred, not so much by want of study of the lead cell as by want of knowledge of the general behaviour of lead compounds during electrolysis, and even by ignorance of the reactions occurring on the electrolysis of sulphuric acid. In these circumstances, we can look for little help from the dissociation theory, nor has it, as Mr. Wade remarks, thrown any light on the problems presented, and thermochemical calculations cannot be of great assistance either.

We have dealt with Mr. Wade's book at some length, but not at a greater length than its merits deserve. It only remains to give a word of praise to the illustrations, which, especially in the case of the pictures of different grids and supports, are very clearly executed, and considerably enhance the value of the book.

MAURICE SOLOMON.

BIOLOGY OF THE LAKE OF GENEVA.

Le Léman. Monographie limnologique. Tome troisième, première livraison. Par Prof. F. A. Forel. Pp. 411. (Lausanne: F. Rouge, 1902.)

IN this, the first portion of the third volume of his interesting work, Prof. Forel treats of the biology of the Lake of Geneva, and describes with his customary wealth of detail the various forms of life observed in and upon the waters of the lake. From a biological point of view, Prof. Forel divides the lake into three regions: (*a*) *littoral*, extending from the shore line down to a depth of fifteen metres; (*b*) *abyssal* (*profonde*), comprising a layer of water about two metres in depth extending from the littoral region all over the bottom of the lake; (*c*) *pelagic*, the great mass of water beyond the littoral region and above the abyssal region. The fauna and flora are classified in accordance with these three regions, and as the animals and plants exist in intimate biological relation, they form what Prof. Forel describes as "sociétés," so that there is a "société" pertaining to each region. Descriptions and illustrations are given of the methods and apparatus employed in collecting the organisms in the different regions, and in the sorting out and separation of these organisms when obtained.

The first half of the book is occupied chiefly with a full list of the organisms constituting the fauna and flora of the lake. Prof. Forel enumerates in all nearly one thousand species. Many of these, however, such as the bats and some of the birds, have no claim to be considered natives, but, like *Homo sapiens*, who heads the list, resort to the lake in search of a living. On the other hand, there are many species peculiar to the lake, among which the most interesting are those adapted to live at considerable depths. The most remarkable of these abyssal forms are the blind Crustacea, *Asellus Foreli* and *Niphargus Foreli*, but most of the groups of animals occurring in the lake have representatives in the deep fauna. Among plants, the only peculiar abyssal form is a moss, *Thamnium Lemani*, found at a depth of nearly 200 feet, yet brilliantly green.

In some groups, the lake is very rich in species, while in others it is surprisingly poor. This may be partly due to some groups having been more thoroughly studied than others.

Of the seven species of mammals noted, one, the beaver, is extinct, two, on Prof. Forel's own showing, have not yet been recorded with certainty, while three are classed as "erratic" or adventitious, leaving only the otter as a regular inhabitant. There is a long list of

birds, many of them mere visitors. Of the forty-two species of Entomostraca, only seven are recorded as pelagic, but a large number occur in the deep region.

Of the twenty-six Rotifers recorded, the majority, fifteen, are pelagic. It is probable that further work in the littoral region would considerably extend the list. Many species of Rhizopods extend into the abyssal region, and several are peculiar to it. Among the Algæ, the Diatoms are very numerous, comprising a greater number of species than any other group of organisms, while, on the other hand, the paucity of Desmids is remarkable. Only two species of Closterium represent the typical unicellular group; the only species cited as pelagic is a Hyalotheca, while the genus Staurastrum, so generally present in the plankton of the lakes in this country, is not noted at all.

It is somewhat surprising to find only two Hepatics and three Mosses in Prof. Forel's lists and no Lichens whatever. In dealing with the Mosses, the professor seems to make it a rule only to admit species which are permanently submerged, a rule which, applied all round, would greatly curtail his lists.

The second half of the book is devoted to the study in detail of the plant and animal associations of the various regions and to the discussion of many interesting problems offered by the life of the lake. Into most of these problems, concerning the origin of the various associations, the migrations of the plankton, &c., we cannot here enter, but several of the more interesting points may briefly be noticed.

Prof. Forel insists on the recent origin of the flora and fauna of the lake, in common with those of all regions which have undergone a glacial epoch. He remarks on the cosmopolitan character of the pelagic population. A remarkable fact is the occurrence of Chironomid larvæ and air-breathing Molluscs at great depths. Without any apparent modification of their structure, both these animals seem to be able to adapt themselves to the altered conditions found at the bottom in the deeper parts of the lake when casually transported thither. When brought to the surface, the air-tubes and air-cavity are found to contain water. After exposure for some time in shallow water, they resume the normal mode of breathing. Prof. Forel further points out that those Chironomid larvæ which had become adapted to breathe water would thereby be prevented from rising to the surface to pass into the winged state. He asserts that as a matter of fact they never are observed to emerge from the water except in the littoral region, and discusses the possibility of the insects breeding pedogenetically, as is known to occur with some species, but considers it more probable that they are all casually introduced.

Some notes are given of the occurrence of albino cygnets among the broods of swans on the lake. There is also a reproduction of an interesting old plate, dated 1581, from the Library of Geneva, giving sketches and notes of nineteen species of fishes frequenting the lake. Mention is made of a fungoid disease, attributed to *Saprolegnia ferax*, which attacked the pike in the lake in the years 1886 and 1887, destroying large numbers of all sizes. The work is valuable as a comprehensive summary of the biology of a large lake, and will be of much service to those who are making similar studies of other lakes.

The second and concluding part of the third volume of Prof. Forel's monograph on the Lake of Geneva will, it is understood, deal with the pile-dwellings, fisheries and other relations of man to the lake.

OUR BOOK SHELF.

A Monograph of the Land and Freshwater Mollusca of the British Isles. Vol. ii. Part viii. By J. W. Taylor, F.L.S. Pp. 52; 5 pls. col., figs. in text. (Leeds: Taylor Brothers, 1902.)

WITH the present part, this work enters on its long-awaited second volume, containing the systematic portion. The first volume was devoted to a sort of general introduction to the study of the Mollusca, with special reference to British forms, and left much to be desired; but this second section should prove of great value, seeing that for many years past the author, ably seconded by Mr. W. D. Roebuck, has been patiently amassing a large amount of very valuable information concerning the distribution and variation of the British non-marine Mollusca. So extended, however, is the plan on which the work is projected that further co-operation is invited and will, we hope, be readily given.

As compared with other works of its kind, the present one is noteworthy for the greater length at which the various details concerning each species are treated and for the introduction of new features of great importance. Anatomy receives its proper share of attention; but too much space is bestowed, and mostly wasted, on variations that are quite unimportant scientifically. In this section especially, more careful editing is required to remove the too obvious traces of mere compilation and to introduce a better sense of proportion between the different parts.

The geographical distribution of the species is, however, the strong feature of the work, and here an innovation of very great value is introduced, for, besides detailed records in the text, the range of each species in the British Isles is shown on a separate, coloured map, indicating (*a*) districts from which the author has actually seen specimens, (*b*) areas for which the species has been recorded by other observers, and (*c*) regions in which it probably occurs. To these we hope the author will add indication (say by dots) of districts formerly occupied by a species (*e.g. Acanthinula lamellata*) the range of which has become restricted in recent times. Distribution over neighbouring areas of the continent is shown on maps in the text.

The inclusion of forms entirely fossil (*e.g.* Glandina from the Eocene) is another, welcome, new departure, and here, as in the geological histories, we believe, although it is not so stated, Mr. R. B. Newton rendered some assistance (*cf. Journ. Conch.*, x. p. 74).

The illustrations in the text are mostly good, but here and there is one unworthy of the rest (*e.g.* No. 52).

Plate i., with coloured figures of Testacella, is an excellent example of tri-colour printing, but the artist must surely have had wooden models to draw from.

One would have expected to have found a more modern classification adopted than that set forth on the opening page, but what was selected should have been correctly followed. The branch Euthyneura, which was established by Spengler, and not by Lankester as stated, is not synonymous with the order Pulmonata, which is only one of its subdivisions.

These and other minor blemishes, however, do not affect the value of the work in its entirety, and when completed the author will undoubtedly have made a most important contribution to the literature on the study of our British non-marine Mollusca. (BV)².

Interest and Education. The Doctrine of Interest and its Concrete Application. By Prof. C. DeGarmo. Pp. xiii + 226. (New York: The Macmillan Company, 1902.) Price 4*s.* 6*d.* net.

THE masters in English secondary schools have in the past been a little impatient of philosophical treatises dealing with the principles underlying educational practice; they have been apt to recognise education as an art, though unwilling to give attention to writers anxious to formulate a science of education. While fond of insisting upon the value to the teacher of individuality and freedom of action, our schoolmasters have failed to understand that until they have discovered and can apply the principles of their art, they are mere empirics, each knowing only what he has learnt from personal experience. The greater attention given in America and Germany to the training of teachers has incidentally resulted in the growth of a body of able men devoted to the study of educational science. Prof. DeGarmo, of Cornell University, is one of these students of pedagogic problems, and the book before us, with its evidences of enthusiasm on every page, represents some of his recent work. Taking Schurman's dictum as his text, that "interest is the greatest word in education," he shows how interest arises among primitive men, what its object should be, how it can be made to assist in the delimitation of the curriculum, and what relation it has to methods of teaching. Prof. DeGarmo has no sympathy with those intellectual aristocrats who cherish archaic educational ideals and deny the badge of scholarship to all who do not accept their estimate of the value of Greek and Latin. He attaches as much importance to rational instruction in science as to the making of Latin verses—"the student in the scientific, the technological or the commercial course is not inferior to his brother in the arts course . . . difference is not inferiority." He quotes approvingly, too, Lord Kelvin, who has said, "the higher education has two purposes—first, to enable the student to earn a livelihood, and second, to make life worth living," and this book should greatly assist teachers so to educate their pupils as to make both these requirements possible of attainment.

A. T. S.

The Theory of Optics. By Paul Drude. Translated from the German by C. R. Mann and R. A. Millikan. Pp. xxi + 546. (London: Longmans and Co., 1902.) Price 15*s.* net.

A VERY full account of the German edition of the above work appeared in these pages rather more than two years ago (October 18, 1900), under the title "A Modern Text-book of Optics." To what was then said little need be added. Prof. Michelson, in his preface to the translation, expresses the facts when he writes, "But no complete development of the electromagnetic theory in all its bearings, and no comprehensive discussion of the relation between the laws of radiation and the principles of thermodynamics have yet been attempted in any general text in English."

Prof. Drude's book fills the gap, and we may well agree with Prof. Michelson in his opinion that by making the book accessible to English-reading students, the translators have done an important service.

The translation has been well done; to the English reader the get-up of the book has an unfamiliar and not quite pleasing appearance, due to its American origin, and the illustrations of apparatus are not as good as we are accustomed to see in books of the class, but this does not really detract from the high merit of the work.

An index, which was wanting in the German edition, has been added, but the references to original papers, especially papers of historic interest, are singularly incomplete. The book does not pretend to develop the subject from the historic standpoint, it is true, but still the omissions noted are very marked.

In spite of these, the book is of very real value, and should be found on the shelves of every physical laboratory.

Le Forze Idrauliche. By Ingegnere Torquato Perdoni. Pp. 205; with four plates. (Milan: Ulrico Hoepli, 1902.)

IN a country like Italy, where coal has to be purchased from abroad, the utilisation of natural sources of available energy is an important problem. In this volume the author gives in tabular form a list of the principal water courses of the Italian mainland, and estimates, so far as information will permit, the amount of horse-power obtainable from these (*a*) under normal conditions ("magra ordinaria") and (*b*) during the dry seasons of the year ("minima magra"), exceptional droughts being excluded. Between these two limits, there is a large amount of energy available during the greater part of the year, which might be utilised if provision were made for supplying the deficiency during the dry months, and one method suggested is to apply this water power to electric traction on the railways, supplementing it in the summer by the use either of ordinary locomotives or steam engines at the generating stations. Of other sources of energy, the sea with its tides and waves is considered, and even glaciers are mentioned in connection with the property that a cold body may act as a store, if not of *energy* (as the author implies), at any rate of *availability*. This distinction between energy and availability might with advantage be pointed out clearly in the introduction, which deals with "the unity of concepts in modern physics," but in which the part devoted to matters thermodynamic is suggestive of Carnot's *caloric* theory of the motive power of fire rather than of the second law as modified by Clausius.

De Ether. By Dr. V. A. Julius. Pp. 56. (Haarlem: De Erven F. Bohn, 1902.)

L'Etere e la Materia ponderabile. By Ingegnere M. Barbèra. Pp. viii+134. (Turin: Bertolero, 1902.)

THE first of these pamphlets consists of a discourse given to a vacation class of teachers in April, 1902, shortly before the death of the author. It was published at the request of many members of the class, and is as good a general historic account as could possibly be given in so short a space of our knowledge of the ether, considered with regard to optical phenomena, starting with the corpuscular theory of Newton, and tracing the various theories of Huyghens, Fresnel, Cauchy, Lord Kelvin, Maxwell, Fitzgerald, Larmor, Lorentz, and other writers.

Signor Barbèra's book is of a very different nature. In it he endeavours to account, without the use of mathematical formulæ, for the whole of the phenomena of modern physics and physical chemistry, on the supposition that the ether like matter consists of an aggregate of material particles, and that it differs from matter only in its very small density and very great elasticity. In the fifth paragraph he discusses the propagation of transverse waves on the hypothesis that the ether is a *fluid*. The motions which he describes in this connection are, however, well known to readers of hydrodynamical text-books as those produced by a sphere moving or oscillating in liquid. The book is up-to-date so far as the inclusion of recently discovered physical phenomena is concerned, but no theories of the ether can be adequately discussed in a pamphlet of this size and character, however carefully written.

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.]*

Sir Edward Fry on Natural Selection.

I ASK leave to make a few observations on Mr. Galton's letter under the above heading which appeared in your issue of February 12.

In my papers on the age of the inhabited world and the pace of organic change in the *Monthly Magazine* lor last December and January, I had a passage on the difficulty which appeared to me to exist in conceiving mimetism to have been produced by the gradual accumulation of minute points of likeness. On this Mr. Galton observes that "two objects that are somewhat alike will be occasionally mistaken for one another when the conditions under which they are viewed are unfavourable to distinction." If by "somewhat alike" Mr. Galton means have some point of likeness, however minute, then the proposition would refute my objection; but it would, as I think, be manifestly untrue. If, on the other hand, by "somewhat alike" be meant a considerable likeness, then the proposition is manifestly true, but leaves unanswered the difficulty on which I have dwelt, viz. the difficulty of seeing how natural selection could have helped the organism to convert minute points of likeness in the midst of unlikeness into such a preponderance of likeness as to produce deception.

Mr. Galton has illustrated his point by the fact that "i" may often be mistaken by the beholder for "l," "k," or "h." But here he starts with an obvious and considerable likeness, and the question is, how could that degree of likeness be reached by natural selection?

Let us take two sheets of paper, the one a *tabula rasa*, the other covered with a thousand dots arranged so as to produce a highly complicated pattern. Then let dots appear successively, but sporadically, on the white paper in places where there are dots on the other paper, until, in the end, the two papers are indistinguishable. It seems to me to be obvious that for a long while no eye would mistake the one paper for the other; but that, as the process goes forward, a point will be reached where an occasional mistake will occur under conditions unfavourable to distinction. Now I agree that it is conceivable that from this point forward natural selection may operate, but as to the whole interspace between the first minute change that deceives no one to the point of first deception, it appears to me plain that natural selection cannot operate at all, and that the theory of the accumulation of minute variations, therefore, fails to account for the facts of mimetism in insects and other organisms.

If the two suggestions of sudden and great variation on the one hand, and of the slow accumulation of small variations on the other be considered as the possible explanation of the facts of mimetism, I cannot but think that the latter will be found far more probable than the former; and therefore, whilst willingly admitting the great weight to be attributed to the opinion of Mr. Galton on the subject, I remain unconvinced.

But suppose that on this point I am wrong and Mr. Galton is right, does he not judge my argument with undue severity when he treats it as "so faulty as to seriously compromise the value of the memoir as a whole"? My observations on mimetism are not the basis of my argument, which is a collection of facts which appear to show the existence of sudden and heritable variations. They are a part, and a separate part only, of an argument that the accumulation of minute variations will not account for some known facts attributed to it. The inculpated paragraph may be struck out of my paper, and all the rest will stand unaffected. Even if this error, if error it be, has compromised not a single passage only but the whole of my paper, I am glad to find that Mr. Galton is in sympathy with its general purport, and I thank him for the courteous language which accompanies his condemnation of my lapse. EDW. FRY.

Failand, February 23.

The Assumed Radio-activity of Ordinary Materials.

WITH reference to Mr. Strutt's recent article and Prof. J. J. Thomson's letter on this subject, may I venture modestly to urge that it may be well to consider whether the condition set up in air to which attention is directed be not the outcome of the occurrence of a minute amount of chemical change of an ordinary character—whether it be not a sort of Russell effect on an infinitely minute scale, detected by an infinitely delicate test? That oxidative change is in continual progress, I imagine, is the belief of everyone who has paid the slightest attention to the subject; and that leaf surfaces—if not waterfalls—are the certain seat of such changes may be regarded as unquestionable. Those of us who require something more than an attitude of papal infallibility in proof of a scientific proposition would like to see the old love honourably retired before the new one is accepted in society. HENRY E. ARMSTRONG.

The Dissociation Theory of Electrolysis.

IN a recently published "Text-book of Electrochemistry," by Svante Arrhenius, and translated by Dr. McCrae, I find on p. 114 of the translation the following statements:—

"Even when working with polarisable electrodes . . . the smallest fall of potential is sufficient to cause a current in the liquid. This fact was proved by Buff with currents so small that it was only after months that a cubic centimetre of explosive mixture was obtained. According to this the very smallest force is sufficient to split the molecules of the Grotthus chain . . . Faraday's view is therefore incorrect. The radicles of the salt molecule cannot be held together by a force of finite value."

The ideas of current and electromotive force are here rather mixed, but obviously the passage refers to a very necessary part of the foundation of the dissociation theory of electrolysis, viz. that a minute E.M.F. can evolve in the free state the ions of an electrolyte the heat of combination of which is considerable.

On referring to Buff's papers (*Lieb. Ann.*, lxxxv. p. 1 and xciv. p. 1), I find no mention of an evolution in the manner described of any explosive mixture whatever; taking this to mean free oxygen and free hydrogen evolved simultaneously by an E.M.F. less than that of one Daniell's cell. Indeed, towards the end of his second paper, Buff incidentally states that a single cell produces merely a polarisation which almost stops the current.

Surely in the attempt to found a theory in opposition to that of Faraday some modicum of care should be taken to verify the sources of information.

In "Outlines of Electrochemistry," by Prof. Harry C. Jones (1901), we find at p. 15 the same kind of statement, that the dissociation theory accounts for, and is founded on, experimental evidence, showing that "a very weak current" can decompose water and set free its constituents simultaneously. Here also the word "current" is used, though "E.M.F." is apparently meant.

No reference is given, but the statement occurs in a discussion of the well-known Clausius theory. In his description of this theory (*Pogg. Ann.*, ci. p. 338), Clausius certainly does not mention, and apparently did not believe, that any such phenomenon could occur.

It would be interesting to know if anyone has ever observed it.

At all events, the acceptance of the theory in question is certainly not encouraged by an encounter with such serious errors in the description of experiments put forward as its foundations. J. BROWN.

Analysis of the "Red Rain" of February 22.

SOME of your readers will probably be interested to know something of the nature of the muddy rain which fell here on Sunday, February 22. A sample of the downfall, caught in an open field between 10 a.m. and 12 noon, was brought to me to examine, and particulars of the partial analysis of the suspended matter which the water contained are subjoined. The large percentage of organic matter seems to me to be the most remarkable point in the analysis, and I regret not having had time to make a separate investigation of this. A rapid examination of the physical proper-

ties of the sediment, or mud, which I made, seemed to indicate that the organic matter was condensed hydrocarbon gases, or condensed volcanic vapours (such as one might expect to be evolved unburnt in a very large volcanic outburst). The sediment seems to be terrestrial, as the large amount of organic matter, coupled with the small amount of iron found, prohibits the theory of a meteoric origin.

The rain water contains 37·0 grains of suspended matter, or mud, to the gallon.

The analysis of the suspended matter, dried at 100° C., is as follows :—

Organic matter (loss on ignition) ...	36·4	per cent.
Silica	45·6	,,
Alumina and oxide of iron... ...	13·6	,,
Magnesia	2·4	,,
Unclassified	2·0	,,
	100·0	,,

Buckfastleigh, March 2. ROWLAND A. EARP.

Proof of Lagrange's Equations of Motion, &c.

IN your issue of January 29, Mr. Heaviside put forward a demonstration of Lagrange's equations of motion which appears invalid. As neither his interpretation of Newton nor his argument based thereon was stated with sufficient clearness to enable a critic to locate the weak spot without running serious risk of misinterpreting him, it seemed better in the first instance to point out a well-known case in which precisely similar reasoning would lead to Lagrange's equations of motion where they are known to be untrue (the reason, and a proper remedy, being also generally known). This I did in your number of February 19; his reply, in the same number, is to the effect that he does not intend to uphold the truth of Lagrange's equations in such a case. It is not, however, logically permissible for anyone to escape the inconvenient consequences of his own argument in such a fashion.

Possibly Mr. Heaviside has not grasped my point. If the argument he puts forward on p. 298 is valid, I am unable to see any point at which the following can without inconsistency be alleged to fail :—"In the case of a rigid body rotating round a fixed point with angular velocities ω_1, ω_2, ω_3 about its principal axes the kinetic energy T is a homogeneous quadratic function of the ω's, with coefficients which are constants. This makes

$$2T = \omega_1 \frac{aT}{d\omega_1} + \omega_2 \frac{dT}{d\omega_2} + \omega_3 \frac{aT}{d\omega_3} \qquad (8)$$

therefore

$$2\dot{T} = \omega_1 \frac{d}{dt}\left(\frac{dT}{d\omega_1}\right) + \dot{\omega}_1 \frac{aT}{d\omega_1} + \ldots \qquad (9)$$

But also by the structure of T,

$$\dot{T} = \dot{\omega}_1 \frac{dT}{d\omega_1} + \dot{\omega}_2 \frac{dT}{d\omega_2} + \dot{\omega}_3 \frac{dT}{d\omega_3} \qquad (10)$$

So, by subtraction of (10) from (9)

$$\dot{T} = \omega_1 \frac{a}{dt}\left(\frac{dT}{d\omega_1}\right) + \omega_2 \frac{d}{dt}\left(\frac{dT}{d\omega_2}\right) + \omega_3 \frac{d}{dt}\left(\frac{dT}{d\omega_3}\right) \qquad (11)$$

and therefore, by Newton, the torque about the first axis is the coefficient of ω, *i.e.* $A\dot{\omega}_1$, and similarly for the rest."

There is no step in his demonstration which requires that the coordinates should be "proper Lagrangian coordinates within the meaning of the Act"; in the proof usually given there is such a step.

It is with great diffidence, lest I may do Mr. Heaviside injustice through misinterpreting him, that I now venture to express the conjecture that in his argument he may possibly have failed, as is sometimes done [by Maxwell, for instance, "Treatise," second edition, § 561, equations (5)], to distinguish between the displacements which a material system actually receives during its motion and displacements which are perfectly arbitrary subject only to the geometrical connections of the system, and have thus confounded the equation

$$X_1 v_1 + \ldots = \left(\frac{d}{dt}\frac{dT}{dv_1} - \frac{dT}{dx_1}\right) v_1 + \ldots$$

which expresses that the rate at which work is done by the forcives is equal to the rate at which the system gains kinetic energy, with the very different one

$$X_1 \delta x_1 + \ldots = \left(\frac{d}{dt}\frac{aT}{dv_1} - \frac{dT}{dx_1}\right) \delta x_1 + \ldots$$

in which δx_1, &c., are arbitrary displacements as above. When the latter equation is established, Lagrange's equations follow at once, but Mr. Heaviside has made out no case for deducing them from the former. In every case, as in the example I cited, the right-hand member of the former equation can be written in the form

$$v_1 \varphi_1(x_1, v_1, \dot{v}_1, x_2, \dot{v}_2, \dot{v}_2, \ldots) + \ldots$$

in an infinite variety of ways, and accordingly it is sufficiently obvious that there is no warrant for stating that the force on x_1 is the coefficient of v_1 in any one such form more than in any other. Samples of expressions which might thus be wrongly obtained for the torque about the first axis in the instance alluded to are

$$A\dot{\omega}_1,\ A\dot{\omega}_1 - (B - C)\omega_2\omega_3,$$
$$A\dot{\omega}_1 + (B - C)\omega_2\omega_3,\ A\dot{\omega}_1 - (B\omega_2^3 - C\omega_3^3)/\omega_1.$$

For the simpler case of a particle moving in a plane, one could thus obtain, for example, the equations,

$$X = m(\ddot{x} - k\dot{y}),\ Y = m(\ddot{y} + k\dot{x}),$$

where k is any quantity whatever.

In short, the latter of the two equations compared above differs from the former in being equivalent to a set of independent equations equal in number to that of the coordinates of the system.

Similar remarks apply, of course, to his treatment of the question of an elastic medium, p. 297.

That the Principal of Energy, or of Activity, does not by itself afford a sufficient basis from which to formulate the fundamental equations of dynamics in any form whatever is admitted almost universally; from Mr. Heaviside's letters it appears at least doubtful whether he is willing to agree with this general and well grounded opinion; he has advanced no valid argument against it, however. W. McF. ORR.

February 22.

A FEW weeks ago you published in a letter from Mr. Heaviside a proof of Lagrange's equations of motion of a system of bodies. I must confess that I in common with others swallowed it, but I have now come to the conclusion that the proof, though doubtless admirable as an example of the power of the "Principle of Activity," does not prove Lagrange's equations. In fact, if q be a coordinate, $\dot{q}$ the corresponding velocity, and Q the corresponding force, we have the result

$$\Sigma \dot{q}\left\{\frac{d}{dt}\frac{\partial T}{\partial \dot{q}} - \frac{\partial T}{\partial q} - Q\right\} = 0$$

for any possible motion of the system. But we are not entitled to equate the quantities in the brackets to zero, for *these are not independent of* $\dot{q}$. The "proof" is, in fact, merely Maxwell's well-known but fallacious proof, simplified by going direct instead of *viâ* Hamilton.

Cambridge, February 28. R. F. W.

Genius and the Struggle for Existence.

PERMIT me to point out that Dr. A. R. Wallace's statement (p. 296), "the comparatively short lives of millionaires," is not supported by facts, at any rate by those for the last three years.

The following has been obtained from the details concerning estates on which death duties were paid. Nine millionaires died during 1900, leaving in the aggregate 19 millions. The average age of these nine testators is seventy-four—the youngest was fifty-nine and the oldest ninety-one years.

During 1901, we find that the deaths of eight millionaires are recorded, whose joint estates were valued at 10½ millions. In this case too, we find that the average age is above the allotted threescore years and ten, being seventy-two. The

youngest in this year was fifty-three, and the oldest—Baron Armstrong—was ninety.

Last year—1902—the same story is repeated. Five millionaires died in 1902, and their average age is seventy-eight. It is also worth remarking that if our inquiries are carried further, it will be noticed that longevity is a striking feature of those whose estates are valued at between 500,000*l.* and 1,000,000*l.*

It seems to me that one might have expected this state of things to exist, if we consider how the wealthy—through their wealth—can secure the advantages of change of scene, change of climate, scientific progress, and last, but not least, the aid, skill and advice of our greatest doctors and surgeons. One would have liked to take up other points, but I fear I have already taken up too much of your valuable space.

S. IRWIN CROOKES.

Secondary and Technical Schools, Clay Cross,
Chesterfield, February 17.

IN some respects it appears to me that the excellent remarks of Sir Oliver Lodge and Mr. A. R. Wallace (NATURE, lxvii. pp. 270, 296) leave this difficult subject in an unsatisfactory condition.

All inquirers have perceived that great men are of two types, and it would conduce to clear thinking if we could accustom ourselves to classify them under different names. To define them exactly is impossible, for no man of great genius is without talent, and no man of great talent is without some genius.

The first class, to which I should prefer to restrict the name genius, may be described primarily as men of fine, delicate, sensitive, impressionable constitution, and strong, restless innate tendencies which appear early in life, as a rule, and take their own shape. These men work energetically, often at high pressure, and in general die comparatively young, or at least do not often reach a robust old age. They are fearless rather than circumspect, have the ability and courage to open out in new directions of thought and action, are creative, original, daring, and possess either an exquisite sensibility or a wonderful and tenacious faculty of logical thought. They are, as it were, impelled from within, and are thus able to resist the almost overwhelming influence of social example, and the ties of relationship, exhibiting, for the most part, more independence than their times can tolerate or understand. They introduce most of the new ideas into the world, and touch nothing they do not transform. They are always men of strong practical feeling in their own special vocation, but scarcely ever practical in the sense of turning every opportunity to their own advantage. Indeed, the height to which they soar is largely due to their detachment from worldly interests and conventions, and their lack of regard for self, though this may be consistent, and is often found in conjunction, with excessive vanity and egotism. They take a sympathetic interest in human affairs, and are most commonly liberal in sentiment, but their actions are often narrow and sometimes indefensible. Frequently they are simple, direct, guileless, not so much unversed in as opposed to the diplomatic ways by which men succeed; but contact with the world is apt to spoil them, and their very logic leads them into extremes. Despite abundant energy, their powers of resistance are not great, and they most often reach high eminence in music, poetry, painting, philosophy and science, where activity lies somewhat remote from the tension and bustle of practical life. They are said to be inspired because of the enthusiasm, and unconscious working, of their minds.

The second class I would describe as men of talent. When preeminent they exhibit striking aptitude in learning and in imitation, and develop extraordinary powers of work. They are generally men of strong, vigorous build, firm mind and healthy body. They are, accordingly, marked by general sanity of ideas, preferring to think and act in conformity with prevailing conventions rather than to startle men with novel views. Except perhaps in their own particular sphere of activity, they are conservative in character. They possess a clear conception of the value of this world's goods and graces, accumulate honours, and become, in general, more reputable than illustrious. They do the bulk of the world's hard mental work, and are more concerned to protect and improve existing institutions than to seek new methods or discover new paths. When they do achieve greatness it is more by virtue of immense knowledge and systematic exposition, or of amazing industry and technique, than of original and independent views. What Galton says of English judges applies with all its force to men of talent in general: they "are vigorous, shrewd, practical, helpful men; glorying in the rough-and-tumble of practical life, tough in constitution and strong in digestion, valuing what money brings, aiming at position and influence, and desiring to found families."

As described, these are of course ideal types, to which actual men more or less approximate. But they are well enough distinguished in nature for mutual antagonism. The man of talent is apt to laugh at the genius; and the genius too often sneers at the man of talent. The one is pushing, the other retiring; the one looks for and obtains immediate reward, the other works for fame and posterity. Compared with the man of talent the genius is a rare phenomenon. But this may be because so many geniuses are sacrificed before their activity has produced lasting results, for the existing environment is not favourable to them. As typical of the genius I would name Chopin, Mozart, Beethoven, Raphael, Goethe, Shakespeare, Keats, Shelley, Kepler, Galileo, Newton, Faraday, Descartes, Spinoza; and of the great men of talent Aristotle, Velasquez, Virchow, Hegel, and, indeed, those numerous men who have attained eminence rather through enormous receptivity and power than by acuteness and creative faculty.

These types once fairly discriminated, it is not so difficult to determine their relation to the struggle for existence. Great men, in proportion as they approach the second type, are the more clearly useful in the immediate needs of life, and this, in plain language, is the only usefulness conserved by natural selection. Whoever supposes that natural selection is a being with eyes directed towards the future has wholly misconceived it. Men of genius not only leave few, inferior, or no offspring, but too often find it difficult to live. And explain it how we will, the public opinion that neglects men of genius during their lives is natural selection. Genius never conquers except when the ideas and works to which it gives origin are taken up and put to practical use by men of the second type. If the ideas are beyond the men of talent, they are as much neglected as the geniuses, until such time as the world has made progress in its own slow way. There are many ideas now in printed books which are waiting for recognition by men of talent. Much of the work of genius has very little bearing on the struggle for existence. Music and painting, for example, except in so far as they are a source of profit to instrumentalists and collectors, and to teachers of these arts, do little more than give pleasure and consolation mostly to those who seek refuge from the struggle which, though concealed by many conventions, is real and searching enough beneath the surface of civilised life. The error lies in supposing that everything comes into existence by virtue of natural selection, when in fact natural selection is only a convenient expression to sum up the action of causes which conduce to survival and persistence. In nature there is great variety, and genius, so far, is one of the varieties which often recur, but scarcely ever survive even for two generations. It is a rare and delicate thing, and the utmost we can hope for it is that endeavours may be made to collect and preserve it like some hot-house plant, in order that it may suggest combinations which men of talent may put to practical account.

The position of the second type in the struggle for existence is beyond doubt. The stability of a country and its place among the nations depend upon the number and ability of men of this stamp. They obtain rewards precisely because of their usefulness. They found families by reason of their strength and virility, and their steadfastness, cheerfulness and conservatism of character are as much the expression of their bodily make as the instability and originality of the man of genius are the expression of his keen sensibility, and his daring suggestions a proof of bodily discomfort and profound dissatisfaction with the conditions of life and knowledge.

But we are only on the verge of these studies, which are hardly yet within the reach of scientific method, and we have acquired very little insight into the collective action of

natural selection in preserving nations. Our gaze is too intently fixed on the individual struggle, and we are more ready to revert to old abstract notions of inner springs and guides, set for some noble and unknowable purpose, than to develop the one fruitful idea of progress by the natural and predictable interaction of parts. ARTHUR EBBELS.

February 16.

THE ORGANISATION OF FISHERY RESEARCH.[1]

IN August, 1901, a committee, since known as the Committee on Ichthyological Research, was appointed by the Board of Trade in order "to inquire and report as to the best means by which the State or local authorities can assist scientific research as applied to problems affecting the fisheries of Great Britain and Ireland, and in particular whether the object in view would best be attained by the creation of one central body or department acting for England, Scotland, and Ireland, or by means of separate departments or agencies in each of the three countries." The report of this committee, together with the minutes of evidence laid before it, has now been published.

The appointment of a committee of inquiry by Government is, I am afraid, generally regarded as having the effect of postponing, or even avoiding, any effective action on their part. In the present case, however, we have the somewhat exceptional situation of real action being taken whilst the inquiry was still in progress, and that action in a direction which is, to some extent, at variance with the course eventually recommended by the committee. For whilst the Ichthyological Committee were still engaged in hearing the evidence of experts of various degrees of authority, and by all the subtleties of cross-examination causing them to commit themselves—as is plainly indicated in the evidence of most of the witnesses—to statements which, after a little reflection and in more collected and rational moments they would rather have expressed differently, the Government decided to take part in the scheme of international investigations which was receiving somewhat rough treatment at the hands of the committee, and persuaded Parliament to vote considerable sums of money for that purpose. The Government are to be congratulated upon having taken definite practical action, even though a minor result of that action has been to cause the report of their Ichthyological Committee to be brought, as it were, with but enfeebled vitality into the world.

The question referred to the committee was, nevertheless, one of considerable importance, and their answer to it—if not of immediate moment—will probably be not without influence in the future. In a general way, the question how the State or local authorities can best assist scientific research as applied to fisheries is quite simply answered by saying that they can do so by supplying the most capable and trustworthy scientific men whose services they can obtain with the necessary funds to carry out such research. The only real difficulty is to find some scheme of organisation which will ensure that the men employed are both naturally and by experience and training the best fitted for the work, that thorough, accurate and really scientific workers are distinguished from such as are ostentatious and superficial, and that those failing to maintain their efficiency, or to carry out the work assigned to them, are speedily eliminated.

Two other matters of importance are, however, involved in the terms of reference of the committee. In the first place, what should be the exact relations existing between the men charged with carrying out scientific research and those whose duties are connected with fishery administration; and, in the second place, to what extent is it advantageous that the researches carried on in different parts of the United Kingdom should be placed under one central control.

On the subject of the relations of the administrative and scientific departments, the committee express a quite clear and definite view. They are of opinion that the responsibility for and the control of the scientific investigations should be in the hands of the central administrative authority, and that the most important of the researches should be directly carried out by this authority. In suggesting a new arrangement for England, they, however, propose the establishment of a central council, composed, in approximately equal numbers, of administrative and scientific men, whose duty it should be to advise the administrative authority (Board of Trade) on all matters concerning scientific research. No provision is suggested by means of which this council could enforce its decisions.

In my opinion, it is open to the gravest doubt whether such a direct control of scientific work by an administrative body is likely to lead to satisfactory results. The trustworthy information and assistance required by the administrative body are, I feel sure, much more likely to be obtained from a more independent scientific authority acting as advisers to the administrators, an authority the preponderating influence of which is in the hands of recognised men of science. Such an arrangement will render the selection of capable naturalists far more probable, and will ensure the naturalists being in a position to give that complete concentration of their whole energies upon the problem in hand which is so absolutely essential to successful scientific work. The claims of administration are immediate and pressing, and when they are combined with the claims of scientific research, experience has repeatedly shown that the latter are bound, sooner or later, to take a secondary place. Huxley's experiences as an inspector of fisheries are a sufficient illustration of this point.

The objection urged by the opponents of the view here advocated is that the method is less likely to lead to immediate practical results. Unfortunately, there is no short and easy road to results which are sound and scientific, and the adage "More hurry, less speed" is, I fear, more than usually applicable to work of this kind.

On the second question—a question to which the attention of the committee was particularly directed—namely, to what extent there should be central control of the investigations throughout the United Kingdom, the committee also make a definite recommendation. Recognising the fact that separate administrative authorities are already established in England, Scotland, and Ireland, and in view of their opinion that the scientific investigations should be controlled by the administrative authority, the committee consider that the researches in the three portions of the kingdom are best kept separate. In order, however, to secure some measure of uniformity of action amongst the three bodies, they propose the establishment of a quarterly conference of experts representing the English, Scottish, and Irish departments. But there seems little likelihood that such a conference, which, as in the case of the English council, it is not proposed to endow either with authority to enforce its decisions or with any power of action of its own, would be an instrument of much effective value. The scheme is in part the result of a desire, with which I entirely sympathise, to ensure to the workers the maximum of freedom and individual initiative, combined with such centralisation as shall prevent undue or unnecessary waste of energy. But would not these objects be attained more effectually

[1] Report of the Committee on Ichthyological Research. (London: Eyre and Spottiswoode, 1902.) Price 4s. 1d.

and simply by the appointment of a single individual, in whom responsibility could be fixed, and under whose general direction the heads of the scientific departments in the three portions of the United Kingdom would act, a considerable measure of individual authority and initiative being at the same time accorded to each?

Whatever scheme may be adopted, it seems to me to be the duty of all naturalists to insist that the preponderating control of the investigations, as I have already urged, shall be in the hands of recognised men of science, for unless this is so there can be no guarantee that they will be carried out by scientific methods and with that accuracy and thoroughness without which no results of any permanent value can ever be obtained.

E. J. ALLEN.

MAGNETIC WORK IN NEW ZEALAND.

THE "Report of the Department of Lands and Survey, New Zealand," for 1901–2 contains an account of the new magnetic observatory erected in Christchurch,

FIG. 1.—Magnetograph House.

New Zealand, and of the magnetic work to be carried on there under the direction of Dr. Coleridge Farr. The site of the observatory buildings in Hagley Park appears, from the illustrations in the Survey "Report," to be one of considerable natural beauty. It would also seem to be very suitable from a magnetic standpoint, if we may judge from the preliminary survey carried out by Dr. Farr in the neighbourhood of Dunedin, Invercargill, Nelson and Christchurch. Of all the districts examined, he found the vicinity of Christchurch the most free from local disturbances.

The observatory consists of three separate buildings, externally of the Swiss chalet type. Photographs of two of these are here reproduced from the Survey "Report." Fig. 1 shows the magnetograph house, or, to be strictly accurate, the superstructure above the underground cellar in which the magnetographs are lodged. Fig. 2 shows the office buildings, which also serve to accommodate a seismograph. The third building, not shown here, serves for the taking of the absolute magnetic observations.

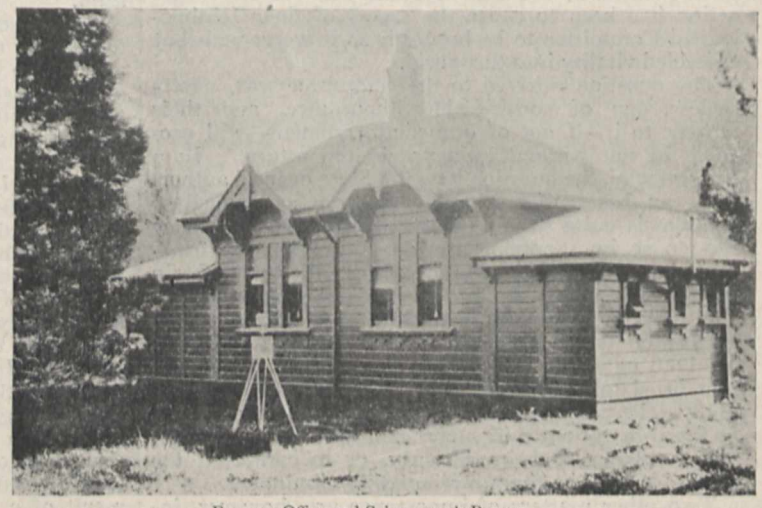

FIG. 2.—Office and Seismograph Room.

The magnetic equipment of the observatory consists of a self-recording magnetograph by Adie and a unifilar magnetometer and dip circle by Dover, all of the ordinary Kew pattern, and examined, prior to their dispatch to New Zealand, at the National Physical Laboratory (Kew Observatory). In addition, Dr. Farr has temporarily the loan of a second unifilar and dip circle belonging to the Royal Society, intended primarily for survey work. Besides the magnetic instruments, the observatory possesses a Milne seismograph, a Kelvin water-dropper and two portable electrometers, for determinations of atmospheric electric potential, and a "dissipation apparatus" of the type invented by Elster and Geitel for determining the rate of loss of electric charges from an insulated body.

After the arrival of the magnetograph in New Zealand, Dr. Farr had the clock modified so as to allow of rapid as well as slow rotation of the drum carrying the photographic paper. This slight modification—which has been made independently by the directors of the Melbourne and Mauritius Observatories—admits of open time-scale traces being obtained as satisfactorily with the ordinary Kew pattern magnetograph as with the newer types by Eschenhagen and others. This modification has allowed Dr. Farr to participate fully in the international scheme of magnetic observations agreed on in connection with the present German and British Antarctic expeditions. In fact, during the call of the British vessel, the *Discovery*, at New Zealand, he arranged with Commander Scott an extension of the scheme of rapid registration, which it is hoped may increase its usefulness. The modification of the clock presented Dr. Farr with an opportunity of an unexpected character, of which full use was made. Zealously aided by his assistant, Mr. Skey—at what must have been considerable personal inconvenience—he succeeded in getting a practically continuous quick-run record for eighty hours during the occurrence of a succession of earthquake shocks. Part of one of the magnetic curves is reproduced in the "Report," showing a curious sinuous trace, and a complete comparison of the corresponding records from the magnetograph and seismograph may be expected to elicit valuable information as to the nature and cause of the movement of magnets at times of earthquake. The frequent repetition of such an opportunity is, perhaps, hardly to be desired, but there can be no doubt that in New Zealand, at least, the combination of magnetic and seismological investigations is a happy one.

Previous to the existence of the new institution, there was in the whole of Australasia only one magnetic observatory, that at Melbourne. This fact and the general scarcity of such observatories in the southern hemisphere make the observatory at Christchurch of

much more than local importance. It has already afforded the magnetic staff of the *Discovery* a most valuable opportunity of comparing their instruments and practising their use in southern latitudes, of which they fully availed themselves, and when it comes to dealing with the magnetic data of the Antarctic expeditions, the Christchurch records should prove invaluable.

The public spirit and the appreciation of scientific aims shown by the New Zealand Government in providing the necessary funds for erecting and maintaining the observatory is of happy augury. It shows that war is not the only department in which the colony is anxious to come to the front.

Though hardly referred to in the "Report," mention may also be made of the fact that, prior to the erection of the observatory, Dr. Farr took magnetic observations with the instruments lent by the Royal Society at about 150 stations scattered over New Zealand, about half in each of the two principal islands. This constitutes an important contribution to the complete magnetic survey of New Zealand, which Dr. Farr puts forward as part of the programme which he intends to prosecute as circumstances allow. The objects which Dr. Farr has in view will meet with warm sympathy from all interested in the extension of our knowledge of terrestrial magnetism, and it is to be hoped that his efforts will meet with the continued support necessary for their complete realisation.

CHARLES CHREE.

THE KEARTON SELBORNE.[1]

GILBERT WHITE'S famous natural history classic has already seen something over eighty editions, and the appearance of yet another may be taken as a sure indication that its popularity shows no signs of waning. Indeed, in these days of "nature-teaching," it is quite likely to become, if possible, more widely read than ever, since there are few works in the English language better calculated to show the value of the intelligent use of the eyes or better suited to aid in the cultivation of the powers of observation. If anything could increase the popularity of one of the most popular books in the world, it would be the addition of illustrations of a modern type, faultless in execution and appropriate in subject. To furnish such pictures, no living artists, we venture to say, are better qualified than the Messrs. Kearton. Their success in this particular instance speaks, as usual, for itself; and we shall perhaps best serve the interests of both artists and publishers if we ask those of our readers who may be disposed to doubt our words to judge for themselves.

It should, however, be stated that this edition of White is a low-priced one, intended for the general public, and in no sense an *édition de luxe*. It is of small size and printed in small type, and most of the illustrations are therefore of necessity also on a rather microscopic scale. In the case of views of the village and the neighbouring country, such as that of old cottages on p. 88, this detracts but little, if at all, from their effectiveness; but it must be confessed that some of the photographs of bird-life, such as the one of an osprey and its nest on p. 78, would have been improved had it been practicable to reproduce them on a somewhat larger scale.

In his introduction, the editor claims that the illustrations are in closer touch with the spirit of the author than any which have previously appeared, and this we can fully endorse. What, for instance, could better illustrate White's observations on the young cuckoo and its foster-parents than the exquisite photograph on p. 130 of a sedge-warbler watching one of these usurpers which has expelled the rightful occupants of the nest? Or what could be more appropriate to the author's account of the Selborne ring-ousels than the illustration (herewith reproduced) of these birds feeding their young?—an illustration actually taken in the Selborne country, which cost the Messrs. Kearton at least a week's watching to obtain. At the risk of being considered hypercritical, we cannot, however, refrain from mentioning that the photograph of swallows on a telegraph-wire (p. 139) is somewhat of an anachronism in an eighteenth-century work. Again, on p. 35, a figure of harvest-mice and their nest would have been much better than the one of common mice; but perhaps to obtain the former was impossible even to a Kearton. We also think that a photograph of a fallow-buck with fully developed antlers should have replaced the one on p. 27, in which these appendages are less than half-grown. In other respects, we have nothing but commendation to bestow on the illustrations, both as regards subject and execution.

Although brief, Mr. R. Kearton's notes are very much to the point, and give all the information required by ordinary readers in regard to modern emendations on White's zoological determinations. We note, however, that the editor has not seen fit to follow modern views in regard to the nomenclature of bats. The book appears singularly free from misprints (although we notice an unfortunate one on p. xiv.) and is admirably got up. It would be an insult to say that it is calculated to add to the Kearton reputation, since this is an impossibility, and we can do no more than commend it to the attention of all in search of an attractive gift-book.

R. L.

FIG. 1.—Ring-ousels feeding their young. From the Kearton "Selborne" (Cassell and Co., Ltd.)

[1] "The Natural History of Selborne." By Gilbert White. With notes by R. Kearton and illustrations by C. and R. Kearton. Pp. xvi + 294. (London: Cassell and Co., Ltd., 1902.) Price 6*s.* 6*d.*

RECENT CONFERENCES BETWEEN SCIENCE MASTERS AND EXAMINERS.

DURING the past year or so signs have not been wanting that the unfortunate separation between teaching and examining, which has so often been deplored, is likely, before very long, to be either mended or ended. And we think that both the representatives of the Universities and the subcommittee of the Public School Science Masters' Association are to be congratulated on the new departures that were made at Cambridge on Saturday, February 7, and Oxford on Saturday, February 14, when they met at conferences summoned by the Vice-Chancellors of the respective Universities, to consider the question of entrance scholarships in the natural sciences given at the several

colleges in Oxford and Cambridge, from the point of view of the teaching of science in public schools. For, though the representatives of the Universities did not accept all the proposals brought forward, they did accept a large proportion of the chief of them, as, for example, the proposal to limit the number of chief science subjects offered by any candidate to two, and another requiring all candidates offering geology, or biological subjects to show an acquaintance with the elements of chemistry and physics, and thus a real beginning in the direction of greater cooperation was made.

We do not, however, attach so much importance to the results attained by these first conferences as we do to the fact that the conferences were held at all. For we feel sure they will be followed by others, that the science masters will be imitated by the masters of other departments, and that whatever the immediate results may be, however great or however small, we might almost say however good or however bad, they will sooner or later—and we think sooner—do much to disentangle many knotty questions, and by generally improving the relations of those who teach and those who examine, do good work both for individuals and for the State, to both of whom the advancement of education is admittedly of vital importance. We hope and believe, moreover, that now the representatives of the colleges at Oxford and Cambridge have led the way in thus conferring directly with the assistant masters, who, in the nature of things, must do most of the actual teaching in the schools, other public bodies concerned with education, such as the University of London and the Civil Service Commissioners, will not be backward in promoting similar conferences whenever there may seem to be a reasonable prospect that they may prove useful. Some examining bodies in the past have been too timid in the matter of reform, and have shown far too much fear of giving the schools a lead, forgetting that the evil of going too slowly may be even greater, at times, than that of going too fast. Conferences like those we are now recording should be immensely helpful to such conservative bodies by giving them the best possible opportunities of getting into touch with the actual educators.

Hitherto, circumstances have tended far too much to make the teachers in schools look upon examiners solely as critics rather than as friends and colleagues. The recent action of the University of London in appointing schoolmasters to examine schoolboys, the proposed consultative committee to assist the War Office on educational questions, and these recent conferences at the old Universities, give good ground for hoping that this state of things is about to pass away, and that teachers and examiners will soon be pulling together more universally than they have done hitherto.

NOTES.

DR. J. LARMOR, secretary of the Royal Society and Fellow of St. John's College, has been elected to the Lucasian professorship of mathematics at Cambridge, in succession to the late Sir George Stokes.

AT a seismological congress held at Strasburg in April, 1901, statutes were proposed for an international seismological association. The German Government now invites delegates from various countries to meet to discuss these propositions. We learn from *Science* that this meeting will take place at Berne in May.

THE British and African Company's steamer *Bornu*, which arrived at Plymouth on February 27, experienced a heavy sand-storm on February 19, in latitude 27° north, longitude 15° 30′ west, that is, a little south of the Canary Islands. A tremendous sea prevailed for several hours, and so dense was the sand that it was impossible to see either end of the ship from the bridge.

PROF. KOCH has been elected a Foreign Associate of the Paris Academy of Sciences, in succession to the late Prof. Virchow.

WE regret to see the announcement of the death of Prof. W. Harkness, astronomical director of the U.S. Naval Observatory, and Rear-Admiral (retired) of the United States Navy.

PROF. E. MAZELLE has been appointed director of the Imperial Astronomical-Meteorological Observatory at Triest, Austria.

THE twenty-first congress of the Sanitary Institute will be held this year in Bradford, commencing on July 7. The programme of arrangements made will be given in the supplement to the April *Journal* of the Institute.

REUTER states that a telegram has been received in New York from Mr. Aymé, the United States Consul in Guadeloupe, stating that the French army engineers have established communication with Martinique by means of wireless telegraphy.

REPORTS from Mexico state that the volcano Popocatapetl has been bought up by a group of American financiers for the sum of 1,000,000*l*. The idea is to utilise the valuable deposits of sulphur contained in the volcano, to get which it will be necessary to construct a railway to the summit.

DR. J. W. GREGORY, F.R.S., professor of geology in the University of Melbourne, has met with an accident, necessitating an operation under chloroform. He was conducting scientific investigations in Tasmania at the time, and considerable anxiety has been felt concerning him. The latest news is, however, reassuring.

THE President of the Local Government Board states that the Royal Commission on Sewage Disposal is taking evidence and making investigations on the subject of dangerous contamination of shell-fish by sewage, with a view of ascertaining the measures necessary for obviating risk to the public health from this cause.

MR. W. BOWMAN writes from Kansas City, Missouri, U.S.A., with reference to the flexure of a white marble slab mentioned in NATURE of November 20, 1902 (p. 56) and November 27, 1902 (p. 81). He says that many years ago he saw at Windsor, Nova Scotia, in the churchyard of the old parish church, a marble slab bowed in the middle, exactly as described by our correspondents.

MR. HENRY PHIPPS has given Lord Curzon another 10,000*l*. for the promotion of agricultural education or scientific research in India. Colonel Lockwood has been informed by the Secretary of State for India that, in view of the great benefits conferred on the European and the native community in India by the Pasteur Institute in the Punjab, the Viceroy proposes to apply half Mr. Phipps's gift to the establishment of a similar institute in Southern India.

IN the House of Commons on Tuesday the following resolution was moved :—"That the constitution of the Board of Trade has become obsolete, and this House is of opinion that a department presided over by a Minister of Commerce and Industry, having the *status* of a principal Secretary of State, should be substituted for the present office, to which should be entrusted all matters more particularly appertaining to commerce and industry, and to that end that an

inquiry should be forthwith instituted with the view of re-arranging the duties and functions of existing departments." After discussion, both the resolution and an amendment to it were withdrawn.

CENTRAL NEWS despatches from Mexico City report that an eruption of the Colima Volcano commenced on February 21. The disturbance continued practically incessantly until February 24, on which date, at 5.15 a.m., there occurred the most violent eruption known at Colima for many years. At 2.26 a.m. a severe earthquake shock was felt at the town of Tuxpan, near the volcano.

THE Carnegie Institution has made grants to several of the professors of Johns Hopkins University to assist original researches. Prof. Harmon N. Morse has received 300*l.* for an assistant in his researches upon the new method he has evolved for measurement of osmotic pressures; Prof. R. W. Wood 200*l.* to maintain a research assistant; Dr. H. C. Jones 200*l.* for an assistant in his researches in physical chemistry; and Prof. J. J. Abel 200*l.* for the apparatus necessary to his researches in physiological chemistry.

THE council of the Society of Arts, at the request of the executive committee of the International Fire Prevention Exhibition, to be held at Earl's Court during the current year, has decided to offer the following prizes at the exhibition, out of the funds of the Fothergill Trust:—One gold medal, two silver medals and two bronze medals for the best chemical fire engines for town use shown at the exhibition; and similar medals for the most easily worked long ladders, to reach the sill of a window eighty feet above the level of the pavement, which shall also be capable of being rapidly transported over roads not more than twenty-five feet wide.

THE annual general meeting of the Institute of Chemistry of Great Britain and Ireland was held on March 2, when the council presented its report. The council has appointed Prof. J. Millar Thomson (the retiring president), Mr. G. T. Beilby and Dr. J. Lewkowitsch to represent the Institute at the International Congress of Applied Chemistry to be held at Berlin in June next. The council has, whenever occasion has arisen, urged upon authorities making appointments under the Sale of Food and Drugs Acts, the importance of requiring applicants to produce evidence of adequate training in theoretical and practical chemistry, and of special experience in the analysis of food and drugs.

ON February 26 the Italian Minister of Marine and a number of naval experts witnessed some interesting experiments with Signor Siglio's apparatus for giving warning of the approach of submarine craft and other vessels. The Central News correspondent at Naples says that the approach of a large steamer was notified by the apparatus when the vessel was twenty kilometres distant. The approach of a small boat was signalled at a distance of twelve kilometres.

REUTER'S Agency is informed that a strong and unusually well-equipped expedition is on the point of being dispatched to South Africa by the Chartered Company, for the purpose of completing up to Lake Tanganyika the scientific survey of Rhodesia. The expedition will be absent about three years, and will sail from England in time to reach Cape Town at the beginning of April. The work now in contemplation has only been rendered possible by the completion of the Cape to Cairo telegraph up to Tanganyika, which now enables the explorers to synchronise with the observatory at Cape Town. The expedition will have far-reaching results in finally determining the exact geographical position of many important centres at present imperfectly laid down upon the maps. The work is under the direct supervision of Sir David Gill, K.C.B., F.R.S., Astronomer Royal at the Cape.

WITH the object of bringing to public notice the economic mineral products of Ireland, the Department of Agriculture and Technical Instruction for Ireland has arranged for the Irish minerals shown at the Cork International Exhibition of 1902 to be placed on view in London. These, together with a few additions, are now to be seen at the Imperial Institute, and the exhibition remains open, admission free, for three months from February 26. The most important materials are building stones of various kinds, mainly limestones and granites; and amongst the polished marbles and granites, excellently suited for ornamental purposes, there is considerable variety. Samples of clay and sand, and of pottery and glass manufactured from the same, are shown. Coals and iron-ores are of some importance, but the metalliferous ores of lead, copper and zinc occupy only a small space. Other minerals include bauxite, gypsum, barytes, salt and diatomaceous earth; slates and paving materials are also well represented. According to the official mining statistics, the minerals annually raised in Ireland amount in value to only about 1/400th part of the total output of the United Kingdom; and it is sincerely to be hoped that this exhibition may have some effect towards developing the mineral resources of Ireland, even though these be not so extensive and varied as could be desired.

MAJOR-GENERAL C. J. B. RIDDELL, C.B., F.R.S., whose death is announced at the advanced age of eighty-six, was one of the pioneers in the cultivation and extension of work in terrestrial magnetism and meteorology. Concurrently with the arrangements made in 1838-1839 for an expedition to the Antarctic regions arose the question of the desirability of extending the contemplated magnetic researches in the southern hemisphere by the establishment of fixed observatories in certain of the British colonial possessions, which should also carry on meteorological inquiries. The stations mentioned were those of St. Helena, the Cape of Good Hope and Toronto. Lieutenant Riddell was selected as director of the Canada (Toronto) branch, subject to the instructions of the Ordnance Department and Major (afterwards General) Sabine, R.A. In 1841 the reduction work for the publication of vol. i. of the Toronto observations was commenced by Sabine, who had the assistance of Riddell, and much commended the practical merits of the system inaugurated at Toronto. General Riddell was responsible for the "Magnetical Instructions for the Use of Portable Instruments Adapted for Magnetical Surveys and Portable Observatories, and for the Use of a Set of Small Instruments for a Fixed Magnetic Observatory," which was printed at the expense of the Government and issued in 1844. He outlived all his associates in magnetic observational work. At the time of his death he enjoyed the unique distinction of being the senior Fellow of the Royal Society in respect of election.

ON February 25 Dr. M. W. Travers gave a lecture on the "Measurement of Low Temperatures" before the Chemical and Physical Society of University College, London. In the experimental demonstrations a thermometer was used of the constant volume type described in the *Phil. Trans.* for 1902, in which the temperature is read directly on the manometer. In the course of the lecture the bulb of the instrument was immersed in liquid hydrogen when the thermometer indicated a temperature of $20^{\circ}\cdot5$ Abs. Solid hydrogen was prepared by boiling the liquid hydrogen under a pressure

of about 5 centimetres by means of a Fleuss pump. To illustrate the differences obtained in measuring the same temperature with thermometers filled with different gases, Dr. Travers concluded by giving his results for the boiling point of oxygen and hydrogen on the scale of various thermometers :—

Oxygen B.P. (He) 90°·20, (H) 90°·10, (N) 89°·5, (O) 89°·0
Hydrogen B.P. (He) 20°·41, (H) 20°·22.

These results are in agreement with Prof. Callendar's calculations based on a consideration of the physical properties of hydrogen and helium, according to which the boiling point of hydrogen on the absolute scale should be 0°·1 lower than the boiling point as given by a hydrogen thermometer and 0°·1 higher than that given by a helium thermometer.

DURING the past week the British Islands have been visited by a succession of disastrous gales from the Atlantic, accompanied by tremendous seas. The most destructive storm was that of February 27, the centre of which advanced quickly from the south-westward, and was central over Scotland on the morning of that day. The barometer fell there for nearly twelve hours at the rate of more than a tenth of an inch an hour. It was during this gale that a railway train was capsized on the Leven viaduct, near Ulverston, and the havoc to telegraph wires was so great that the Meteorological Office was unable to issue any weather forecasts. At Southport during a squall the wind reached a velocity of ninety-two miles an hour, and at Greenwich, which was more than 300 miles from the centre of the disturbance, a pressure of 33 lb. to the square foot was registered in the early morning. Other disturbances have followed very quickly from the Atlantic, and a renewal of the gales, with heavy rains, has occurred over the entire kingdom.

WE have received the German Meteorological Yearbook for 1901, issued by the Deutsche Seewarte—the twenty-fourth volume of the new series of the publication—containing daily observations and results for a large number of stations and hourly readings at four normal stations. There is considerable advantage in the German system of publication, which ensures uniformity in the meteorological volumes issued by various States. We are glad to see that the anemometrical values are expressed in terms of the revised and reduced factor, instead of that originally determined by Dr. Robinson, which assumes that the velocity of the wind moves with three times that of the anemometer cups. In an appendix Dr. H. König discusses the sunshine records obtained from various stations.

THE *Journal des Transports* reports that the Governor-General of French West Africa has recently sent out a surveying party to trace out a new railway in Senegal, between Thiès and Kayes. The line will be about 466 miles in length.

MESSRS. WORMS AND CO., writing to the *Times* of February 26, give the translation of a letter which they have received from the French Under-Secretary of State for Posts and Telegraphs, in which it is stated that a fresh Franco-English Telephonic Convention has just been signed which will permit of telephonic communication between the two countries being extended to provincial towns. The existing convention only authorises communications between Paris and London, but as soon as the new convention has received the approval of the authorities in both countries, this limitation will be removed. This extension, we do not doubt, will be cordially welcomed by the public on both sides of the Channel.

ACCORDING to the *Westminster Gazette* a conference on railway electrification is now being held, at which all the great railways are represented. The main object of the conference is to secure uniformity in electrical plant, so that the rolling stock of the various companies shall be able to travel indiscriminately over any of the lines. Such details as the distance between centre and side rails, design of motors and locomotives and so forth are being considered, and in addition many other points in relation to the electrification of steam railways. It seems that the railways are awakening to the necessity of immediate reform, especially in running their suburban lines. The object of the conference is very important, and one which we have emphasised on several occasions in these columns.

SIR OLIVER LODGE is well known to have been one of the pioneers in wireless telegraphic work, both on the theoretical and practical side; to him belongs the credit of having been the first to suggest the use of tuned systems, and he devised, and published many years ago, methods by which syntony might be practically attained. In addition to this his work on the coherer is not likely to be forgotten. We are glad to learn, therefore, that he has been engaged, in conjunction with Dr. Muirhead, in perfecting his apparatus for both transmitting and receiving, and that the system has now reached a thoroughly practical form. The Eastern Extension Telegraph Co. is experimenting with the Lodge-Muirhead apparatus on its two new cable ships, the *Restorer* and the *Patrol*.

THE daily papers last week contained announcements of three new inventions of a revolutionary character in the field of wireless telegraphy. The first relates to an invention by Mr. P. C. Hewitt, the inventor of the vapour lamp recently described in these columns, who, it is stated, has devised a method of setting up powerful and continuous oscillations in the transmitting mast; no particulars are given. The other two are of a more sensational character, and relate to the transmission of power by ether waves. Prof. Braun, it is said, has declared that he sees no further difficulty in principle, and even no serious technical obstacle to the wireless transmission of power, and Mr. T. H. Williams is credited by the *Westminster Gazette* with having worked out a wireless method of running electric motor-cars which only requires further experiment and more capital to be made commercially practicable. Until more definite particulars are published as to these systems it will be necessary to suspend judgment upon them.

No. 159 of the *Journal* of the Institution of Electrical Engineers, which has just been issued, contains several interesting papers. These include Mr. Swinburne's presidential address, Sir Oliver Lodge's paper on electrons—which is considerably expanded from the spoken address—and Messrs. Hutton and Petavel's paper on high temperature electrochemistry; to these we have already referred in these columns. The greater part of the remaining space is filled by Prof. Fleming's paper on the photometry of electric lamps and the discussion to which it gave rise. Prof. Fleming, in this paper, describes a new form of standard incandescent lamp made by enclosing an "aged" filament in a large bulb, which he states answers very well as a working standard. The paper also deals with some of the many problems which photometry presents, and with the discussion, in which Mr. Harcourt, Dr. Glazebrook, Sir W. Abney, Mr. Trotter, Prof. Ayrton, M. Violle and Mr. J. Petavel took part amongst others, forms a most valuable contribution to the subject from both the theoretical and practical sides.

THE Meteorological Office pilot chart for March directs attention to the unusually cold water observed at various times during last December in mid-ocean, on the Transatlantic steamer routes, surface temperatures as low as 38° to 45° being recorded where the normal values are from 50° to 53°. On the western coasts of the British Isles, also, for about a week from December 5, when an easterly type of weather prevailed, the shore water was very cold, 36° to 38° being recorded even up the west of Ireland, and at Newquay, on the Cornish coast, the minimum was 41°. The general range of water temperature during the month was from 10° to 14° at the western stations, against from 4° to 7° at the east coast ones. At the beginning of February the first ice of the season was drifting down the east coast of Newfoundland and blocking the harbour of St. John's.

A LENGTHY article on "White Water" in the March pilot chart of the Meteorological Office gives many interesting particulars relating to the phenomenon known to seamen as the milky sea, which seems to be more frequently observed in the tropical waters of the Indian Ocean than elsewhere. Various observers describe the scene as "ghastly," "awe-inspiring," "wild, weird and rather ancient marinerish," &c., and Captain Carpenter, of the *Challenger*, states that when in the milky sea a ship seems to be passing through a sort of luminous fog in which all sense of distance is lost; sea and sky seem to join, and there is almost as much danger of collision as in a true fog. Although the phenomenon is doubtless a form of phosphorescence, no adequate explanation of it has yet been arrived at.

A REPORT on the fishes collected in the expedition of 1898 to Socotra and southern Arabia has been communicated to the Vienna Academy by Herr F. Steindachner. In addition to several rare species hitherto only known from the Atlantic Ocean, the collections contained six new forms.

No. 80 of the *Communications* from the Leyden Physical Laboratory contains an account of Dr. L. H. Siertsema's measurements of the magnetic rotation of the plane of polarisation of liquefied chloride under atmospheric pressure. For sodium light the value found is 0'01372, and the rotation dispersion is normal, differing little from that with gases and with water.

UNDER the title "The Practice Curve," Mr. J. H. Bair, in a special supplement of the *Psychological Review*, describes experiments for investigating various aspects of association, such as the relation between the sensory and motor side of our mental life, the processes involved in the formation and modification of habit, and endeavours in general to find a satisfactory physiological and psychological explanation for the phenomena of association.

A PAPER on the protective action of wire gauze against explosions has been communicated to the Vienna Academy of Sciences by Dr. H. Mache. The author considers the case where a homogeneous gas-mixture traverses the gauze with a velocity less than the rate of propagation of an explosion. In this case the flame approaches the gauze, but comes to a standstill in front of it. This effect is attributed to the absorption of part of the heat of combustion by the wires, whereby the rate of propagation of the explosion is decreased. By means of certain assumptions, the author investigates a formula for the distance at which the flame stops short of the gauze.

A USEFUL glossary of the minerals and mineral localities of Texas has been prepared by Dr. F. W. Simonds (*Bulletin* No. 5 of the University of Texas Mineral Survey). Such substances as lignite, pearls, pottery clay and petroleum are included.

IN the *Proceedings* of the Cotteswold Club (vol. xiv. part ii., 1903) there is a detailed account of the Rhætic strata in north-west Gloucestershire, by Mr. L. Richardson, who adds many new particulars relating to well-known sections, and describes some fresh localities. There is also the address of the president, Mr. E. B. Wethered, who discusses the origin of certain Palæozoic sandstones and limestones.

PROF. W. W. WATTS contributes an excellent account of the older rocks of Charnwood Forest, with a map showing the structure of the ground if the Trias and more recent deposits were stripped off (*Proceedings* of the Geologists' Association, vol. xvii., parts vii. and viii.). The structure is that of an anticline traversed by thrust-planes and drop faults. Attention is also directed to the terraced and smoothed surfaces of the granite under Keuper Marl at Mountsorrel. These features are attributed to wind erosion in Triassic times, and they are well depicted in a photographic plate.

"THE Greatest Flying Creature" is the title of an essay by Prof. S. P. Langley, and it is introductory to a paper on the pterodactyl *Ornithostoma ingens* by Mr. F. A. Lucas (Smithsonian Report for 1901, 1902). The questions discussed are:— "What has Nature herself done in the way of large flying machines, and are the birds which we see now the limit of her ability to construct them?" Prof. Langley gives particulars relating to various insects and birds, of the wing surface and its relation to the weight of the creature; and these show that the larger the insect or bird, the smaller is the relative supporting surface. He adds, "The explanation may be very near at hand, but it is not to me evident."

SIGNOR LUIGI BRUGNATELLI describes (*Rendiconti di Reale Istituto Lombardo di Sc. e. Lett.*, 2, xxxv. p. 869) a new mineral, "artinite," from the Valle Lanterna, which is interesting chemically as a basic hydrated magnesium carbonate not before known, and interesting petrologically as a final decomposition product of a peridotite rock. Its chemical formula is $MgCO_3.Mg(OH)_2.3H_2O$. Its hardness is about 2'5, its specific gravity about 2'02, and its mean refractive index about 1'53. It is biaxial and optically negative, but its crystallographic system could not be determined with certainty. It is probably monoclinic.

THE Cambridge University Press has published solutions of the examples in the "Elements of Hydrostatics," by Mr. S. L. Loney, who has prepared this "Key" to his book.

A SELECTION of Dr. G. Stanley Hall's papers on the psychology of children and its relation to pedagogics has been translated into German by Dr. J. Stimpfl, and published by Herr O. Bonde, Altenburg, under the title "Ausgewählte Beiträge zur Kinderpsychologie und Pädagogik." Dr. Stimpfl contributes an introduction, in which he gives an appreciative account of Dr. Hall's valuable studies of child psychology.

THE first volume of "The Fauna and Geography of the Maldive and Laccadive Archipelagoes," edited by Mr. J. Stanley Gardiner, has been completed by the issue of the fourth part from the Cambridge University Press. This part contains papers on the Cephalochorda collected by the expedition of 1899 and 1900, the birds, earthworks, the Maldive and Laccadive groups, with notes on other coral

formations in the Indian Ocean, marine crustaceans and the Lithothamnia. The first part of the second volume will be published next June.

AN index, prepared by Mr. Clement Reid, F.R.S., for De la Beche's "Report on the Geology of Cornwall, Devon and West Somerset," has recently been published for the Geological Survey, and can be obtained from any agent for the sale of Ordnance Survey maps. The Report was published in 1839, unfortunately without an index. No less than 1500 copies were issued, and the memoir is now out of print. It has, however, become one of the classics of geology, and being a permanent work of reference, an index has been a great desideratum, which has now been supplied.

MESSRS. JOHN J. GRIFFIN AND SONS, LTD., have sent for our inspection a simple mechanical device for obtaining rapidly any required set of numbers having the same ratio among themselves as any other given set of numbers. The instrument is known as the "ratiometer," and was designed by Mr. A. E. Munby. It is made of boxwood, and consists of two graduated rules, which can be set at any angle, which with one edge of a T-square form a right-angled triangle. By means of a tongue and groove the base of the triangle slides along the stock of the T-square. The ratiometer should prove of great assistance to examiners for the reduction of marks. It would be useful in laboratories, where it could be used for such operations as the conversion of centimetres to inches, or of scales of temperature, and in the office and workshop for converting one linear scale into another when no simple ratio exists between the two, or for finding the value of various quantities of goods.

THE international committee on atomic weights, organised in 1900, and composed of more than fifty representatives from chemical and other societies, has by vote designated a smaller body of three representatives to carry on the future work of the committee. The three elected members, Profs. Clarke, Thorpe and Seubert, have just issued their annual report and recommendations. It is pointed out that upon the question as to whether oxygen or hydrogen shall be taken as basis of the atomic weight numbers, opinion at the present time seems to be evenly divided. To force the adoption of either appears to be impossible, and experience must be the final arbiter. That standard which best serves to coordinate chemical and physical knowledge will ultimately be chosen, and the other will gradually fall into disuse. Tables are appended to the report in which both standards of atomic weights are represented. In view of recent work, the committee has thought it necessary to make changes and recommendations in respect to the atomic weights of antimony, germanium, hydrogen, lanthanum, mercury, palladium, selenium, tin, uranium and zirconium. Radium appears for the first time in the table with an atomic weight = 225.

UP to the present time very few instances of chemical changes which exhibit periodicity have been observed. Very recently it was found by Ostwald that the velocity of solution of certain samples of chromium in acids does not change in a continuous manner as would be theoretically anticipated, but that the rate of solution increases and decreases periodically. An apparently similar change has been found by Bredig and Weinmayr in the catalytic decomposition of hydrogen peroxide by means of metallic mercury. An account of the authors' experiments is given in the current number of the *Zeitschrift für physikalische Chemie*. In successive intervals of time the amounts of hydrogen peroxide are alternately larger and smaller, and the alternation appears to be simultaneous with a change in the character of the mercury surface. Preliminary experiments indicate that the alternations of the catalytic activity of the mercury are intimately connected with alternations in its electrical condition. In the inactive condition the mercury is considerably more electro-positive than in the active condition.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN MARCH:—

March 10. 4h. 59m. to 5h. 50m. Moon occults α Cancri (mag. 4·3).
14. 11h. 40m. Minimum of Algol (β Persei).
15. Venus. Illuminated portion of disc = 0·904, of Mars = 0·991.
15. Venus. Apparent diameter = 11″·2, Mars = 13″·8.
17. 8h. 29m. Minimum of Algol (β Persei).
18. 16h. 1m. to 17h. 25m. Moon occults χ Ophiuchi (mag. 5·0).
21. 7h. Sun enters Aries, Spring quarter commences.
25. Perihelion Passage of Giacobini's comet (D 1900).
28. 14h. 5m. Annular eclipse of the sun, invisible at Greenwich.
28. 20h. Mars in opposition to the sun.
30. 20h. Venus in conjunction with the moon, Venus 2° 13′ N.

COMET 1903 *a*.—M. Paul Brück, of the Besançon Observatory, publishes an ephemeris for this comet, from which the following is an abstract, in No. 3847 of the *Astronomische Nachrichten*.

Paris 12h. M.T.

Date.	*a*. app. h. m. s.	δ app. ° ′	log *r*.	log. Δ	Brightness.
Mar. 6	0 13 52	+17 27·9			
,, 8	0 18 26	+18 3·9	9·6919	0·0141	18·1
,, 10	0 22 57	+18 31·8			
,, 12	0 27 18	+18 48·1		9·9602	
,, 14	0 31 22	+18 48·5			
,, 16	0 35 3	+18 27·9	9·6251	9·9010	41·3

From an observation by M. Chofardet on February 13, a correction of $\Delta\alpha = +4$s., $\Delta\delta = -0''{\cdot}2$ to this ephemeris was obtained, and the magnitude was recorded as about 9·0.

The comet was observed at Lyons by MM. G. le Cadet and J. Guillaume on various dates between January 21 and 29, and they record it as "a faint nebulosity without elongation and without tail."

A new set of elements, published in the same journal by M. G. Fayet, gives the time of perihelion passage as March 18·7092 M.T. Paris.

COMET 1902 *b* (PERRINE).—An ephemeris for this comet is published in No. 3847 of the *Astronomische Nachrichten*, by Herr Ebell, as a continuation of that which appeared in No. 3841 of the same journal. It indicates that the comet is rapidly becoming fainter, and an observation made at Strasburg on February 17 showed that, on that date, the magnitude was only about 11·5.

HERSCHEL'S NEBULOUS REGIONS OF THE HEAVENS.—Commenting on Dr. Isaac Roberts's recently published results, which indicated that only four of the fifty-two nebulous regions described by Herschel in 1811 really contained nebulosities, Prof. E. E. Barnard remarks that this question is likely to prove an important factor in future discussions as to the physical condition of the universe, and then proceeds to explain that the negative results obtained by Dr. Roberts may be due to insufficient exposure, and that it is highly improbable that Herschel should have been so palpably mistaken in forty-eight cases out of his fifty-two regions.

In support of his argument Prof. Barnard proceeds to describe several photographs, which he has obtained with a 1·5-inch magic lantern lens of 4·9 inches equivalent focus, which suggest that in one or two cases at least Dr. Roberts's conclusions require further consideration.

One striking instance is illustrated by a reproduction showing a great curved nebulosity which embraces the

greater part of the constellation Orion, and of which the brightest part corresponds, in position, with Herschel's region No. 27. Of this region Dr. Roberts remarked "sky clear, stars very few in number, large areas void of stars, no nebulosity," yet the photograph shows a distinct nebulosity in this region, and photographs obtained by two independent observers, with three different photographic telescopes, on several different occasions, confirm Herschel's observations.

Both Dr. Roberts's results and Prof. Barnard's comments thereon appear in No. 1, vol. xvii. of the *Astrophysical Journal*.

A NEW STAR CATALOGUE.—Volume viii. of the *Annalen* of the Leyden Observatory, edited by Dr. H. G. van de Sande Bakhuyzen, is a new catalogue of 10,239 stars situated in the zone 29° 50′ to 35° 10′ north latitude, and having magnitudes of 9·5 or brighter.

The observations have been made and reduced at Leyden, in accordance with the programme of the Astronomischen Gesellschaft, during the years 1870-1876 and 1880-1898, by Messrs. W. Valentiner, E. F. van de Sande Bakhuyzen, E. Becker, J. H. Wilterdink and H. G. van de Sande Bakhuyzen, and the observations of the former period have been already published in vols. iv. and v. of the *Annalen*.

The catalogue gives the position for 1875, the magnitude, the precessional and secular variation in each coordinate, the epoch and the B.D. number (where there is one) for each star, and, in additional tables, these positions are compared with those given in the Bessel, Argelander, Struve and other catalogues for the same objects.

RECENT SCIENCE IN AUSTRIA.

Chemistry.

A PERUSAL of the *Sitzungsberichte* of the Vienna Academy of Sciences indicates that a great deal of valuable chemical research work is being carried out by Austrian investigators. In the concluding section of vol. cx., J. Klimont gives an account of experiments on the composition of oleum cacao which indicate that this substance can no longer be regarded as a mixture of tristearin, tripalmitin and triolein, but that it is essentially a mixed glyceride containing the radicles of these three acids united to one and the same glycerin radicle. Other mixed glycerides containing oleic acid and fatty acids of smaller molecular weight are also present in the fat.

The action of acetylene as kathodic depolarising agent in the electrolysis of acid and alkaline solutions has been investigated by Dr. Billitzer, who finds that this substance readily acts as depolariser with a kathode of platinum, and that the products of its action are ethylene and ethane. Within certain limits of potential, it is possible to obtain a quantitative yield of ethylene. If the potential is gradually increased, mixtures of ethylene and ethane are produced at the kathode, and later hydrogen also makes its appearance. In sulphuric acid solution and with a mercury kathode, small quantities of alcohol are also formed from the acetylene.

The nature of that physiologically most important substance, chitin, has been further investigated by Drs. Fränkel and Kelly. The view advanced by Schmiedeberg that chitin is an α-acetyl-acetoacetic acid compound of chitosamine of the formula $C_{18}H_{30}N_2O_{12}$ can no longer be regarded as correct in the light of this more recent work. This conception of the nature of chitin was largely based on the production of chitosamine and acetic acid by boiling with strong hydrochloric acid, but the authors' experiments indicate that its constitution cannot possibly be of such a simple character.

In vol. cxi., Dr. von Cordier describes a peculiar reaction exhibited by iron and steel. If iron containing carbon and nitrogen is treated with dilute acid and excess of ammonia added to the solution, a distinct odour of carbamine is observable. The author's experiments indicate that the reaction is only obtained if both these elements are contained in the same sample of iron. A mixture of two samples, one containing carbon but no nitrogen, the other nitrogen but no carbon, does not evolve any isonitrile. Investigation of the small quantity of gas given off shows that it is ethylcarbamine.

In a series of papers, Prof. Wegscheider discusses the question of the influence of constitution on the affinity constants of organic acids and gives the results of his experiments on the partial esterification of unsymmetrical di- and poly-basic acids. Special attention is devoted to the alteration produced in the affinity constant by the substitution of hydrogen by ester groups such as SO_2CH_3, CO_2CH_3, $CO_2C_2H_5$ and by the carboxyl group. A considerable addition to our knowledge of this subject results from these investigations. The data obtained are utilised by the author to determine the configuration of the ester acids obtained by partial esterification of unsymmetrical polybasic acids.

Two other papers by Dr. Billitzer treat of the acid character of acetylene and the formation of carbon ions in aqueous solution. In the first of these, the solubility of acetylene in solutions of the alkalis has been studied. By suitable elimination of the physical action of the dissolved bases, it is shown that acetylene undoubtedly forms salts in the alkaline solutions and that it must be regarded as a very weak acid, its dissociation being about 1/4000th of that of carbonic acid. In the second paper, the presence of carbon ions in solutions of silver and copper acetylides is shown by electromotive measurements, and by electrolysis of these solutions under suitable conditions a small deposit of carbon has been obtained on the anode. By two independent methods, the electrolytic dissociation of acetylene has thus been demonstrated.

Physics.

In mathematics, attention should be directed to F. Mertenz's proof of Galois' fundamental theorem of the groups of an equation the coefficients of which belong to a given range of rationality. A construction for the six normals from any point to a conicoid, based on the methods of synthetic geometry alone, is given by Prof. August Adler.

In theoretical physics, perhaps the most extended mathematical investigations are those by Dr. Josef Grünwald dealing with the propagation of waves in uniaxal crystals when the initial disturbances are given. Dr. Grünwald finds for the vector potential a series of waves partly "ordinary," partly "extraordinary" and partly "intermediate" in character. A formula is discussed by G. Jaumann for the heat generated in the motion of a viscous liquid. The expression involves volume integrals of the squares of the curl, and divergence and a surface integral; in the case of an incompressible liquid, this result agrees with the known formulæ in which the only volume integral is that involving the square of the curl. The difficult subject of astronomical aberration and its relation to the ether is discussed by Dr. Egon v. Oppolzer, and in molecular physics, Prof. O. Tumlirz's paper on the "cohesion pressure" terms in Van der Waals's equation, H. Mache's discussion of the relative magnitudes of molecules in a liquid and its vapour, and Dr. G. Jäger's investigation of the law of partition of energy between the liquid and the vapour may be noticed.

In spectroscopy, Dr. Edward Haschek has been working at the relation between wave-length and quantitative composition, and while the conclusions are on the whole remarkably consistent, it appears that at present the method is unsuited generally for laboratory analysis. In collaboration with Prof. Exner, Dr. Haschek has drawn up a list of the spectral lines of europium, including 1193 spark and 527 arc lines. The element europium has also had its magnetic properties compared with gadolinium and samarium by Dr. Stefan Meyer, the preparations of Eu_2O_3 having been obtained from Demarcay.

The diathermanosity of water and certain solutions forms the subject of a paper by Otto Dechant, who finds that as the temperature increases the transparency for heat decreases according to a formula approximately linear. Alum solution is only 2 per cent. less diathermanous than water, but cobalt chloride is better, and its coefficient decreases more rapidly after 50° than between 11° and 50°.

That the freezing points of aqueous solutions are lowered by pressure to a greater extent than that of water is the conclusion of A. Lampa.

In terrestrial physics, a long series of tables relating to rainfall and *inter alia* its supposed connection with sun-spots is drawn up by J. Hann, and Prof. B. W. Stankewitsch describes magnetic measurements made with a "magnetic theodolite" in Pamir during his travels in 1900.

The series of papers on atmospheric electricity includes a comparison of brush electrodes and flame electrodes by Dr. Victor Conrad and a description of a self-registering atmospheric electrometer by Dr. Hans Bensdorf.

Electric discharges form the subject of papers by J. Nabl, in

connection with the gases at the electrodes of the Wehnelt interrupter, and by Dr. Ernest Lecher, in connection with the effect of electrification of the field on the discharge. The electric conductivity of powders is treated by Franz Streinitz.

Speaking generally, the physical papers show a considerable amount of steady, plodding work in the elaboration of existing theories and the tabulation of statistical results rather than any very striking innovations in the direction of new theories.

Zoology.

The systematic position of the armoured dinosaurs from the upper Cretaceous of the Gosau district, originally described, on the evidence of extremely imperfect material, under the names of Struthiosaurus, Cratæomus and Anoplosaurus, has recently occupied the attention of Herr F. B. Nopessa, jun. (*Sitzungsberichte*, vol. cxi. p. 93, 1902). The author follows some previous observers in regarding the first and second of these presumed generic types as identical, as also in considering the third to be inseparable from the Huxleyan Acanthopholis. Consequently, the two genera Struthiosaurus and Acanthopholis have alone to be considered.

The suggestion of the late Prof. Marsh that these European forms are members of the same family (Ceratopsidæ) as the horned dinosaurs of the topmost Cretaceous of North America is discountenanced by Herr Nopessa. Rather, he thinks, they typify a family by themselves—the Acanthopholididæ—in many respects intermediate between the comparatively generalised Stegosauridæ and the highly specialised Ceratopsidæ. From the horned dinosaurs, the members of the intermediate family are readily distinguished by the absence of bony horn-cores on the skull and also of a frill-like neck-shield. They are further characterised by the non-fusion of the cervical vertebræ, the relatively large fore-limbs and the long and powerful tail. As regards the large size of the fore-limb, they are connected with the Stegosauridæ by the Wealden Polacanthus. Taken as a whole, their organisation tends to confirm the view that among the armoured dinosaurs the early bipedal, or partially bipedal, forms are the more primitive, and the quadrupedal types (Ceratopsidæ) the more specialised.

In the same communication, Herr Nopessa describes a chambered vertebra of one of the gigantic sauropodous dinosaurs from the Cretaceous of Neuquen, Patagonia. The reptile to which this vertebra belonged is regarded as generically distinct from Titanosaurus and Argyrosaurus, both of which have been recorded by Mr. Lydekker from the formation in question, but no further attempt is made to determine its systematic position. The sauropodous dinosaurs are now known in the southern hemisphere from both Madagascar and Patagonia.

Mollusca, both recent and fossil, have come in for a considerable share of attention in the issues of the *Sitzungsberichte* recently to hand. In vol. cx. p. 315, Herr R. Hoernes describes new cerithia, belonging to the group typified by *Clava bidentata*, from the Tertiary of Oisnitz, in Central Styria, with remarks on the distribution of that group in the Mediterranean and Sarmatian horizons. The paper is illustrated by a beautifully executed plate. In the succeeding volume (p. 5), Dr. C. Gorjanović-Kramberger treats of the Tertiary cockles of the genus Limnocardium in Croatia, more especially those pertaining to the subgenus Budmania. Some doubt has been thrown on the right of the latter group to distinction, but, from the hinge and other characters, the author justifies its separation from the more typical form. Finally, in the same volume (p. 123), Dr. R. Sturany discusses our present knowledge of the land molluscs of Asia Minor, describing a few new forms.

Botany.

An interesting paper by Prof. Haberlandt gives an account of cultural experiments made with isolated plant cells. These were taken from the mesophyll tissue of the leaf of *Lamium purpureum*, and when placed in culture solutions were kept living for several weeks. Considerable increase in size was observed in some cases, and an appreciable increase in the thickness of the walls occurred, especially where the walls were concave. In the solutions containing only inorganic salts, the chlorophyll corpuscles soon turned yellowish, but kept their green colour when sugar was supplied. It would appear that the plastids pass on all the products of their assimilation and require to be constantly nourished, to prevent decomposition of the chlorophyll. With regard to the renewed growth of the cells when isolated, Prof. Haberlandt regards this as the continuation of growth which is ordinarily arrested in the leaf to suit the requirements of the organism. Two peculiar effects of light are described by Dr. H. Molisch. A flagellate, *Chromophyton Rosanoffii*, shows a large chromatophore which takes up a position on the shaded side. If viewed from the direction in which light rays are impinging upon the organism, at certain angles the cells seem to sparkle. The effect is due to the light which is condensed by the cell on the chromatophore and thence reflected, and is similar to that described for the moss Schistostega. The second paper refers to the light which is emitted by the bacterium *Micrococcus phosphoreus* obtained during the decomposition of meat. The light is sufficiently strong to produce heliotropic curvature in many seedlings, and also in the sporangiophores of Phycomyces.

The poisonous effects so well known in the case of leaves of *Primula obconica* are further elucidated by the investigations of Dr. A. Nestler. Besides various cultivated forms of *Primula obconica*, three species, *Primula sinensis*, *Primula Sieboldii* and *Primula cortusoides*, all belonging to the group *sinensis*, were found to produce similar effects, giving rise to throbbing and inflammation. The source of irritation was traced to the secretions of glandular hairs. These readily crystallise out, and by sublimation were obtained pure. The writer recommends the outward application of strong alcohol as a palliative.

THE FUTURE OF COAL GAS.[1]

WHEN, in the early years of last century, coal gas became a commercial reality, the one end and aim of the manufacturer was to produce his gas, and such details as purity, illuminating and calorific value never troubled his mind. As time passed on, however, and competing companies vied with each other in their endeavours to secure customers, advantages had to be offered to coax consumers from the enemy's camp, and those who remember the battle of the two then existing City companies with another proposed rival in 1847–48–49, and the way in which the gas consumers in the City were at that time pestered and pamphleted by the supporters of the rival schemes, will realise that even in those days gas management was not a bed of roses. The outcome of the rivalry was the introduction in the early 'fifties of a standard of illuminating value, and a string of Parliamentary requirements which have ever since safeguarded the consumer and harried the gas manufacturer.

In 1850 a Bill was passed which enacted that a consumption of 5 cubic feet of gas per hour should be equal to the light of twelve wax candles of the size known as sixes, the burner employed being a brass Argand burner with fifteen holes. In 1860 another Act changed the illuminating power to twelve sperm candles, which meant an increase of some 16⅔ per cent. in the illuminating value of the gas, owing to the fact that the wax candles originally used were only equal in illuminating power to 10.3 sperm candles, as at present employed for testing purposes. In 1868 the illuminating power was again raised to fourteen candles, whilst, in 1876, the present sixteen-candle standard was reached.

The amount of light emitted, however, by the gas was still insufficient to satisfy the desires of the consumers, who, utterly ignoring the fact that the illumination to be derived from coal gas was quite as much dependent on the burners employed as it was upon the standard illuminating value, vented their dissatisfaction at the light emitted by small flat-flame burners by clamouring for a higher quality of gas; and even thirty years ago the great aim of the gas-consuming public was to obtain the highest candle power that could be squeezed out of the gas company, in order that they might gain something like decent illumination from the flat-flame burners then almost exclusively used, and which were, as a rule, so small as to destroy entirely the value of the gas. It was at this period that the anomaly became common of seeing a town supplied with gas of more than twenty-candle illuminating value swathed in semi-darkness, whilst another, using the much-abused thirteen- or fourteen-candle gas, supplied at a good pressure and burnt in decent-sized burners, was well illuminated.

It was at this time, also, that some of our most able chemists ranged themselves on the side of the votaries of

[1] Abstract of Cantor lectures delivered at the Society of Arts by Prof. V. B. Lewes.

high illuminating power, and even such practically minded men as the late Sir Edward Frankland clamoured for the introduction of high illuminating power gas, such as is produced from cannel, in place of sixteen-candle coal gas, the general line of argument being well shown by portions of Sir Edward Frankland's introduction to the section of his published researches dealing with applied chemistry, in which such paragraphs as the following occur :—

"Coal gas is not suitable for use in dwelling houses by reason of its very low illuminating power—100 cubic feet of coal gas containing only 4 cubic feet of illuminating gas; the rest is mere rubbish, which heats and pollutes the air in which the gas is consumed. . . . It cannot be too widely known that coal gas, although it costs less per 1000 cubic feet, is, light for light, much dearer than cannel gas."[1]

Even now, when altered circumstances make a high-power gas an anything but desirable and economical supply, there are not wanting advocates who, undaunted, or perhaps ignorant of the practical side of the question, still try to bolster up the old idea.

It was in the latter part of the 'eighties that the lot of the worried manager was made even harder by the rise in price taking place in cannel coal, on which, up to that time, he had entirely relied in admixture with ordinary gas coal to give those higher grades of illumination demanded by the fashion of the time, and which, although it ruined his coke, yet proved an efficient and trustworthy servant.

This increase in price became so serious that in 1889 the Gas Light and Coke Company commenced experiments which led to the introduction of carburetted water gas in place of cannel as an enricher, this process proving itself a most valuable addition to the manufacture of coal gas, and rapidly gaining favour and popularity, not only as giving an easy means of raising the candle power of poor coal gas, but also as a stand-by in case of any sudden calls upon the production power of the works.

About this same period also, another method of enrichment was introduced, which consisted of adding to gas which did not fulfil the Parliamentary requirements the vapours of such highly volatile hydrocarbons as petroleum spirit and benzol, which, on account of their high illuminating value, gave the necessary increase in the candle power by the addition of an amount of vapour not likely afterwards to recondense from the gas.

Whilst these changes were taking place in gas manufacture, rivals which seemed to threaten its very existence had forced their way to the front, and with the electric light largely used by the rich, and petroleum reduced to a price at which even the poorest could afford its use as an illuminant, the field of utility seemed to be rapidly disappearing from beneath the feet of the gas industry. However, when things were looking their blackest, there slowly struggled into prominence and commercial success a factor which at once restored gas to its position of primary importance.

It was in 1885 that the researches of Dr. Auer von Welsbach culminated in the production of the incandescent mantle, which, frail and unsatisfactory in its earlier forms, was gradually so improved in composition and manufacture that by 1892 it became a brilliant commercial success, and placed in the hands of the gas industry a weapon which rendered its position unassailable in competition with electricity.

Looked at from a common-sense point of view, the incandescent mantle will be seen to be merely a method of enrichment. Instead of increasing the illuminating power of a flame by crowding into the gas more and more hydrocarbons, which during combustion are capable of separating carbon particles, the incandescence of which would increase the amount of light emitted by the flame, and *pro rata* the amount of heating and vitiation, with the mantle you charge the flame with incombustible particles of far greater light emissivity than the carbon possesses, and they do their work without that increase in the temperature and fouling of the atmosphere inseparable from the other processes. It is the introduction of the incandescent mantle and the improvements which are possible in its construction which really give the possibilities to the gas of the future.

Taking the enriched gas as supplied during the 'nineties, the light which can be obtained from it is entirely dependent upon the burner in which it is consumed. This may be stated as follows :—

Light emitted per cubic foot of sixteen-candle gas consumed.

Burner.	Candle units.
Incandescent—high pressure	30 to 35
,, Kern	20 to 25
,, ordinary	14 to 19
Regenerative	7 to 10
Standard Argand	3·20
Ordinary Argand	2·90
Union jet flat flame No. 7	2·44
,, 6	2·15
,, 5	1·87
,, 4	1·74
,, 3	1·63
,, 2	1·22
,, 1	0·85
,, 0	0·59

In considering the value given to the gas by these burners, it is seen that, according to the method by which it is burnt, the consumer may obtain anything from thirty-five candles down to less than one candle per cubic foot of gas. It must also be borne in mind that the burners employed in these tests were all good, well-made burners, giving the best duty that can be obtained from them, whilst an examination of burners used in consumers' houses shows that in most cases any antiquated and corroded burner is considered good enough at which to burn the gas, and the very people who are loudest in their complaints as to the quality of the gas are those who most disregard the method of its consumption.

England is far behind Germany in the use of incandescent lighting, and an inquiry made into the uses to which the coal gas supply of a large town was put gave the following result :—

	Per cent.
Incandescent lighting—private...	12·00
,, public	6·25
Cooking	22·65
Gas engines	6·60
Used in other ways	52·50
	100·00

So that 47.5 per cent. is used for purposes in which illuminating power is of no use and calorific effect is the one important factor.

It is also seen that 18.25 per cent. of the total gas made is used for incandescent lighting, and this represents about 23 per cent. of the gas used for illuminating purposes, as against 90 per cent. used in this way in Germany.

This 23 per cent. thus used gives for a consumption of five cubic feet not less than seventy candles, whilst the average light obtained by the combustion of the remaining 77 per cent. is 8.5 candles.

It is quite clear that under such conditions as these the supply of gas of a high candle power is simply waste of money, and it is manifestly unfair that the consumer of average intelligence, who is willing to utilise the benefits given by the incandescent mantle, should have to pay for a quality of gas only rendered necessary by the inertia of those who decline to march with the times.

Coal gas is daily being used more and more as a fuel, and although the slight diminution of calorific value which must of necessity accompany a lowered illuminating value is a slight drawback, yet in practice any desired temperature can be attained by a slightly larger consumption. Also a cheapening of the gas would induce many to adopt it as a fuel, this in turn tending to level up the load in production, and so to render more economies possible.

Everything clearly points in one direction, and that is, that the future of coal gas is entirely dependent upon a plentiful supply of low-grade gas—low grade from the point of view that it should only have an illuminating value of ten to twelve candles, that its heating value shall be as high as can be practically attained and that its price shall be as low as is consistent with the interests of the consumers as well as of the shareholders in the gas industry.

Already the stream has set in in this direction, and the

[1] Frankland's "Experimental Researches in Pure, Applied and Physical Chemistry," 1877, p. 488.

lowering of the Parliamentary standard of sixteen to fourteen candle power in the case of the South Metropolitan, Commercial and West Ham Companies will soon be followed by many companies now saddled with a higher standard than fourteen candles seeking relief. That relief cannot in fairness be refused, whilst experience of the benefits conferred by the reduction will soon lead to the further step that will place gas manufacture in this country on the same advanced footing that it has already gained in the most progressive cities in Germany.

In making low-grade gas of this character, several processes may be employed, but probably the most economical is to utilise water gas as an aid to the distillation of the coal in the retorts, the proportion of water gas so used being kept down to a point at which the carbon monoxide in the finished gas shall not exceed 16 per cent.

The cheapening in mantles which is now taking place, together with improvements in their manufacture which will give an increased length of life and light, promises a great extension in the use of gas for this purpose.

Another direction in which the future of coal gas will benefit largely, by a cheapening in price owing to economies in manufacture and distribution, will be for use as a fuel. Already the ever-increasing demand made upon the metropolitan companies during the day marks the advance of the utilisation of coal gas for cooking, heating and power, so that whilst the increase in the amount of gas used at night is only rising by some 3 per cent. annually, the day consumption shows an increase of 16 per cent. Directly it becomes possible to reduce the price of gas to about 2*s*. a thousand, advance on these lines will become extremely rapid, and the gas companies are naturally doing everything in their power to foster this development. It is, however, necessary, in order further to popularise gas as a fuel, that everything that can be done should be done to remove any prejudices that exist against heating by gas.

There are many excellent gas stoves on the market, well designed, and giving high heating duty for the gas consumed, but there are also many that, both in their performance and their effect upon the atmosphere, are radically bad. Now that the gas companies have so largely taken over the sale and pushing of gas-heating apparatus, it is a duty they owe to themselves and to their customers to take care that only stoves of scientific construction and good efficiency should be supplied. Many of the worst stoves are the most ornate, and for that reason find their way into many homes, as they, in the first place, appeal to the eye of the housewife, and afterwards to the nose and health of the household, the result being that a good customer is converted into an enemy of gaseous fuel. No gas fires should be sold or let on hire that do not do a large proportion of the heating by radiation, and a gas company that sells a flueless gas stove, save for hall or passage heating, should be prosecuted.

A cubic foot of coal gas on its complete combustion yields 0.52 cubic foot of carbon dioxide and 1.30 cubic feet of water vapour, and if you do not mind breathing hot polluted air highly charged with water vapour, and getting chilled with cold walls, a Bunsen burner stood on the floor is the most effective method of getting the whole of the heat of combustion into the air of the room, and no flueless stove can do more than this. In order to get something to sell, stoves are constructed in which some of the water is condensed, and the public are gravely informed that this removes all deleterious products. But it is impossible to get away from the fact that if healthful heating is to be obtained, it is the solid objects and walls of the room that must be heated, and not the air, and that although some of the heat is lost thereby, a flue to take off all products is an absolute essential.

The gas companies have it in their power to govern the gas-stove trade, and unless they choose to take the initiative, it will retard the popularity of heating by gas to a most serious degree. With all stoves in which solid bodies like asbestos are heated by atmospheric burners, a trace of carbon monoxide is always produced, and if there is not a proper flue passing well into the chimney, a headache is added to the other discomforts.

Improvements in gas motors and gas engines are steadily going on, and as soon as the price of coal gas can be reduced sufficiently to attract this class of custom, a wide field will be opened up for it.

The development of large gas engines during the last few years gives promise of an entire revolution in our methods of procuring power, and it is highly probable that within a very few years the gas engine will make great inroads upon the generation of power by steam. Already gas engines up to 1500 horse-power have been constructed, whilst engines of more than double that power are under construction.

In England, Messrs. Crossley Brothers and other well-known makers are producing a very large number of such engines for driving dynamos, whilst it is stated that on the Continent Messrs. Korting Brothers have made, or have under construction, thirty-two gas engines, with a total of 44,500 horse-power, averaging 1390 horse-power each engine, and the John Cockerill Company and several German companies follow not far behind.

With such a development of gas for motor purposes, it is manifestly the policy of the gas companies to make a determined bid for so wide a field of output, and if they can supply a clean heating gas with 460 to 500 B.T.U.'s heating power, it is clear that the convenience of doing away with separate generating plant would cause a large proportion of this business to fall to their share, if the price of the coal gas could be made to compete with a fuel gas, that is to say, if nearly the same number of thermal units could be obtained by its use at the same cost.

Gas fittings should be entirely taken over by the gas companies, which should supply incandescent fittings and mantles and keep them in order at a small yearly rental; and where swinging brackets and other causes demand flat-flame burners, the companies should fit nipples with broad slits regulated to burn at the lowest possible pressure.

Everything at the present time points to the gas of the future being a twelve-candle-power gas, with a calorific value of not less than 460 B.T.U.'s net and a selling price of not more than 2*s*. a thousand, the economies necessary to reach this lower price being brought about by making the gas in the holder at 9*d*. to 9½*d*. a thousand and distributing it at a considerably increased pressure, the pressure being regulated down to 1½ inches at the entrance to the consumer's meter.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr. C. B. N. Cama, St. John's College, has been elected to the Isaac Newton studentship in optics and physical astronomy.

The Smith's prizemen are Mr. H. Knapman, Emmanuel, second wrangler 1901, and Mr. A. P. Thompson, Pembroke, fifth wrangler 1901. Mr. W. H. Jackson, Clare, bracketed third wrangler 1901, receives honourable mention.

The following have been appointed as representatives of the University to the joint committee of the Royal Society for the purpose of securing an appropriate memorial of the late Sir G. G. Stokes:—The Chancellor, the Vice-Chancellor, Profs. Jebb, Forsyth, Darwin, Ball, Thomson and Mr. W. Burnside.

THE Sedgwick Memorial Museum syndicate, in an amended report, estimates that the cost to the University of the new building, over and above the amount contributed from the memorial fund, will be not less than 18,480*l*.

IT is stated that Mr. David Davies, of Llandinam, grandson of the late millionaire, has presented the University College of Wales, Aberystwyth, with a sum of 20,000*l*.

THE New York correspondent of the *Daily Mail* announces, on the authority of the *New York Journal*, that Mr. Carnegie has arranged to present 200,000*l*. to Princeton University as a thank-offering for his recovery from his recent illness.

LORD AVEBURY will take the chair on March 17 at a conference on higher education at the Institution of Mechanical Engineers, Storey's Gate, Westminster. Representatives of the county and county borough councils and

other educational bodies have been invited to attend the conference by the National Association for the Promotion of Technical and Secondary Education.

IN connection with the seventeenth annual Exhibition of Arts, Crafts and Industries, which will be opened on May 4 in the Town Hall, Hammersmith, by the Duchess of Argyll, a special "nature-study" section has been organised by Mr. W. M. Webb. Prizes and certificates are offered to pupils in schools in Hammersmith for exhibits illustrating, among other subjects, rambles or visits to a park, nature-study diaries, pea plants grown in pots with descriptions of their growth, drawings of living plants or animals, the life-history of any animal (in the wide sense of the word) from personal observation, and nature-study photographs.

THE committee of the Bombay University, appointed to consider the recommendations of the recent Universities Commission, has, we learn from the *Pioneer Mail*, come to the conclusion that both the Senate and the Syndicate work satisfactorily and need not be changed; second-grade colleges should not be disaffiliated; a limit of age and minimum fees should not be fixed, and the study of law should not be concentrated in a central college. Moreover, the Senate objects to interference from outside with the courses of study, and considers that the University should be allowed to control such matters in its own way.

THE Johnston Laboratory at University College, Liverpool, built and equipped by Mr. William Johnston, of Bromborough, will be opened by the President of the Local Government Board on May 9. The laboratory will contain the following departments:—Bio-chemistry, under the direction of Prof. Benjamin Moore; tropical medicine, directed by Prof. Ronald Ross, F.R.S.; experimental medicine and comparative pathology, directed by Dr. A. S. Grünbaum, who will also have charge of the cancer research, for which, as we have already announced, Mr. T. Sutton Timmis recently provided a gift of 10,000*l*. Mr. Johnston has also endowed the professorship of bio-chemistry and three fellowships in various branches of medical research.

SIR OWEN ROBERTS distributed the prizes and certificates to the students of the South-Western Polytechnic on February 23. The report of the principal, Mr. Herbert Tomlinson, F.R.S., was read, and showed the number of adult students in the institute to be rapidly increasing, so much so, indeed, that the volume of work as estimated by the student hours has in the last four years been doubled. During last session upwards of 600 students entered the day colleges for men and women, and nearly 1800 the evening classes. Two years ago large additions, costing 12,000*l*., were made to the buildings, but these proving insufficient, a still further sum of 13,000*l*., provided, like the former sum, by the Trustees of the London Parochial Charities and the London County Council, is now being expended in providing a large hall and further workshop and laboratory accommodation. The long list of successes of students shows that the number of certificates gained during last session was above 150 more than in the previous year, but, as was pointed out by the principal, the proper function of the institute is not merely to prepare students for examinations, but to fit them to earn a living, and the institute owes a good deal of its popularity to the recognition of this by the management.

THE address on science workshops for schools and colleges delivered by Prof. H. E. Armstrong, F.R.S., to the Royal Institute of British Architects last month is printed in full in the *Journal* of the Institute (vol. x. No. 6). Prof. Armstrong illustrated his arguments by reference to the new buildings at Horsham for Christ's Hospital School, of which he is a governor. The science buildings occupy practically one side of the quadrangle, and the floor area of the rooms they contain is 10,326 square feet, while that of the ordinary class rooms of the school only reaches 15,482 square feet. The four chief rooms in the science block are called science "workshops," and are distinguished by the names of Cavendish, Dalton, Davy and Faraday, and to each of these are attached certain subsidiary rooms. No lecture room is provided, since it is desired to discourage didactic teaching—a demonstration bench in the workshop amply provides for any such teaching as is necessary. No special balance room has been introduced, but instead a balance bench—a long narrow table covered by a glazed case for the protection of balances, and arranged at right angles to the working benches. A store or stock room is attached to each of the workshops. There are two kinds of working benches, those for ordinary work and those at which work involving the use of water may be done. The former have teak tops, and the latter are covered with lead. In the rooms on the upper floor, all sinks have been placed near to the walls, and the waste is carried down to the floor below in pipes fixed in chases in the walls. On the basement floor, cross channels have been avoided as much as possible. In three rooms an arrangement has been adopted which provides both a gas service and upright supports to which rings, &c., can be clamped. The space below the bench-top is fitted with two tiers of small cupboards; inside each cupboard is a small drawer. Each bench has four such cupboards, so that four pupils may occupy the place in succession, and each have a cupboard. Prof. Armstrong also gives invaluable hints as to the construction of sinks, drains and ventilation hoods, and describes some special appliances which are in use at Christ's Hospital School. The address concludes with a plea for the simplification of school workshops, and the recommendations are well summed up in Prof. Armstrong's own words, "in designing science workshops the architect . . . should have three S's in mind—*Sense, Simplicity* and *Space*."

SCIENTIFIC SERIAL.

American Journal of Science, February.—Good seeing, by S. P. Langley. A study of the conditions necessary to the formation of a tranquil image in a telescope (see p. 400).—Native arsenic from Montreal, by N. N. Evans. The native arsenic was found in a vein of nepheline syenite at the Corporation Quarry, near Montreal. On analysis it proved to contain 98·14 per cent. of arsenic, 1·65 per cent. of antimony, with traces of sulphur.—Electromotive force in plants, by A. B. Plowman. The experiments described show that the functional activities of a plant give rise to differences of electrical potential in its parts, the intensity and relative sign of these differences depending upon the physiological condition of the plant, as well as upon its electrical conductivity.—The ionisation of water nuclei, by C. Barus.—The morphogenesis of Platystrophia. A study of the evolution of a Palæozoic Brachiopod, by E. R. Cumings.—Note on the condition of platinum in the nickel-copper ores from Sudbury, by C. W. Dickson. An account of the isolation of sperrylite, platinum arsenide, from chalcopyrite.—Lecture experiment on surface tension and surface viscosity, by J. E. Burbank.—Mylagaulodon, a new rodent from Oregon, by W. J. Sinclair.—Studies in the Cyperaceæ, by T. Holm. On *Carex fusca* and *Carex bipartita*.

SOCIETIES AND ACADEMIES.

LONDON.

Physical Society, February 27.—Dr. R. T. Glazebrook, F.R.S., president, in the chair.—A paper by Prof. **Fleming** and Mr. **Clinton**, on the measurement of small capacities and inductances, was read by Prof. Fleming. The measurement of small capacities and inductances has become important in connection with Hertzian wave wireless telegraphy. The authors have designed a rotating commutator which renders the measurement of small capacities a matter as easy as the measurement of resistance on a Wheatstone bridge. The appliance is described in the paper, and the authors claim that they have worked out a thoroughly satisfactory form of rotating commutator, designed more from the point of view of an engineer than an electrical instrument maker. For use with the instrument a moving-coil differential galvanometer has been designed. The authors have made a number of experiments upon the capacity of aërial wires, such as are used in Hertzian wave telegraphy, and have also investigated the laws governing the capacity of such wires when grouped together in certain ways and verified experimentally, as far as possible, the formulæ for the capacity of insulated wires in various positions in regard to the earth. The experiments are given at length in

the paper, and the results practically obtained are compared with those derived from theoretical considerations. In all cases the total measured capacity of n wires is less than n times the capacity of one wire.—Mr. A. **Campbell** exhibited the commutator used for condenser tests at the National Physical Laboratory. It is similar to that designed by Mr. Searle and used by him and Prof. J. J. Thomson in their determination of the value of "v." In this commutator the ebonite insulation does not fill the spaces between the segments, and is never touched by the brushes, thus giving satisfactory insulation. By its aid many measurements have been made of the B.A. air-condensers, the capacity of each of these being about 0·02 m.fd.—A paper on the thickness of the liquid film formed by condensation at the surface of a solid was read by Dr. G. J. **Parks.** It was known more than half a century ago that when a solid is placed in a gas or vapour there is a condensation of the latter on the surface of the solid, and in particular that glass has the power of condensing water-vapour at temperatures above the dew-point. In order to determine the thickness of the liquid film, the author has exposed masses of cotton-silicate of known area to the action of water-vapour. The author has compared his results with those obtained by other experimenters with different substances and under widely different conditions, and concludes that in all cases where condensation of moisture takes place at a solid surface, and at temperatures not below the dew-point, the thickness of the surface-film varies from 10×10^{-6} to 80×10^{-6} cms., according to the substances used and the conditions of temperature and pressure.

Chemical Society, February 18.—Prof. J. Emerson Reynolds, F.R.S., president, in the chair.—The following papers were read:—The molecular arrangement of *N*-substituted imino-ethers, by Dr. G. D. **Lander.** The rearrangement of the atomic grouping .C(OR):N. into .CO.NR. may be effected catalytically or by heating; the author has applied these methods to the study of *N*-substituted imino-ethers recently prepared by him.—The nature and probable mechanism of the replacement of metallic by organic radicles in tautomeric compounds, by Dr. G. D. **Lander.**—The chlorine derivatives of pyridine. Part viii. The interaction of 2 : 3 : 4 : 5-tetrachloropyridine with ethyl sodiomalonate, by Messrs. W. J. **Sell** and F. W. **Dootson.**—The biological method for resolving inactive acids into their optically active compounds, by Drs. A. **McKenzie** and A. **Harden.** The authors have investigated the action of pure cultures of *Penicillium glaucum,* Link; *Sterigmatocystis nigra,* van Tieghem; *Aspergillus griseus,* Link, on various externally compensated acids. Their experiments show that these moulds attack one isomeride more readily than the other, and that the extent of the resolution depends solely on the difference of this rate of attack.—Colour changes observed in solutions of cobalt chloride, by Prof. W. N. **Hartley,** F.R.S. Spectroscopic examination of solutions of cobalt chloride shows that the compound formed when the solution is heated at 93°-100° is the dihydrate $CoCl_2,2H_2O$, whilst solution of the salt in hydrochloric acid appears to result in the production of a compound of the salt and acid; when zinc chloride is added to a solution of cobalt chloride the latter does not become blue on warming; this, it is suggested, is due to the formation of a double chloride of the two metals. The author also points out that the hypothesis that hydrated salts can exist in concentrated solutions and undergo dissociation with rise of temperature is sufficient to account for all the phenomena observed, and the supposition made by Donnan and Bassett of the existence of a complex ion during the electrolysis of cobalt chloride is unnecessary.—The action of ammonia and organic bases on ethyl esters of olefinedicarboxylic and olefine-β-ketocarboxylic acids, by Dr. S. **Ruhemann.**—Derivatives of *p*-aminoacetophenone, by Dr. F. D. **Chattaway.** A description of a number of acyl derivatives of this amino-ketone.

Entomological Society, February 4.—Prof. E. B. Poulton, F.R.S., president, in the chair.—Dr. T. A. **Chapman** exhibited two male specimens of *Orina tristis,* var. *smaragdina,* taken at Pino, Lago Maggiore, on May 30, 1902, still alive; and living larvæ of *Crinopteryx familiella,* second generation, bred from the egg at Reigate, of parents taken at Cannes in February, 1901.—The Rev. F. D. **Morice** exhibited, with drawings of the abnormal parts, a hermaphrodite of *Eucera longicornis,* Linn. In a discussion on hermaphroditism, Dr. Sharp stated that Father Wasman had announced the discovery that in certain Dipterous parasites of Termites the individual commences as a male and ends as a female—a phenomenon entirely new to entomology, though paralleled in some other groups.—Mr. R. **McLachlan,** F.R.S., exhibited a living example of *Chrysopa vulgaris,* Schnd., to show the manner in which this species, which is ordinarily bright green, assumes a brownish colour, the abdomen being often marked with reddish spots in hybernating individuals.—Mr. W. J. **Lucas** submitted specimens of a bug—*Miris calcaratus*—and the fruit of some grass, swept up near Byfleet. The similarity of form and colouring constituted a probable case of protective resemblance.—Major Neville **Manders** exhibited two specimens of an undescribed species of Atella from Ceylon, and remarked that it was a very local insect and only found in the Nitre Cave district, one of the localities most remote from civilisation in the island. It was probably a well-marked local race of *A. alcippe,* but easily distinguished from any known species of the genus by the apex of the fore-wing being entirely black.—Mr. F. B. **Jennings** exhibited two females of *Drymus pilipes,* Fieb., a rare species of the family Lygæidæ, which were found among dead leaves on a hillside near Croydon in September, 1901, and a black aberration of the ordinarily grass-green or yellowish *Miris laevigatus,* L.—Mr. H. J. **Elwes,** F.R.S., exhibited a collection of butterflies formed by Mr. David Hanbury on the Arctic coast of North America, in the region where the Parry expedition was lost. Two of them, including *Colias boothii,* had not been taken since they were first described by Curtis sixty years ago. This species, in comparison with *Colias hecla,* Lef., is undoubtedly distinct in both sexes, but it is most remarkable that the male, in coloration and markings, appears to approximate more closely to the characters usual in the females of other members of the genus. The collection contained nothing new, but included the rare and curious *Argynnis improba,* Butler, hitherto taken only in Novaya Zembla; a remarkable aberration of *A. chariclea,* Schn., in which the black netting marks were resolved into smeared black lines; *A. pales,* for the first time from this region, precisely similar to the form taken on the east of the Lena River in Siberia; and *Coenonympha tiphon,* closely resembling the form from Kamtschatka. He also showed a collection from north-eastern Siberia at about the same latitude, 67°, as the preceding exhibit. It included many species which occur in the western palæarctic regions, most remarkable of all, *Neptis lucilla.* Also *Parnassius delius,* which Mr. Elwes said was the first Parnassius he had seen from within the Arctic circle, and *Colias viluiensis,* Mén., an insect peculiar to Siberia, showing remarkable female aberrant forms.—Mr. C. O. **Waterhouse** gave an account of a nest of a bee, *Trigona collina,* recently received from Malacca. Specimens were exhibited, as were also males and a worker of the much smaller species, *Trigona ruficornis,* Smith, received at the same time from Singapore, and sent by Mr. H. N. Ridley.—Mr. W. J. **Kaye** exhibited two drawers containing Danaine, Ithomiine and Heliconine species from British Guiana, all of similar coloration, and forming a Müllerian association with a black hind-wing.—The following papers were communicated:—On the Hypsid genus Deilemera, Hübner, by Colonel Charles **Swinhoe.**—An account of a collection of Rhopalocera made in the Anambara Creek in Nigeria, West Africa, by Mr. P. J. **Lathy.**—Some notes on the habits of *Nanophyes durieui,* Lucas, as observed in Central Spain by Mr. G. C. **Champion** and Dr. T. A. **Chapman,** with a description of the larva and pupa by Dr. T. A. Chapman.

Zoological Society, February 17.—Dr. Henry Woodward, F.R.S., vice-president, in the chair.—A communication was read from Mr. F. **Pickard-Cambridge** containing descriptions of one new genus and eight new species of spiders of the families Pisauridæ and Senoculidæ, the material for which was contained in the British Museum, and was, to a great extent, obtained by the author in the Lower Amazons.—A communication from Mr. Cyril **Crossland** contained descriptions of two new species of marine polychæte worms obtained on the shores of the Island of Zanzi-

bar, in East Africa.—A communication was read from Dr. Robert **Broom** on the axis, atlas and proatlas of the higher Theriodonts. A description of these bones in the type specimens of Gomphognathus and Trirachodon, now preserved in the Grahamstown Museum, was given, and suggestions thrown out as to the relationship of these forms and Procolophon to the modern Sphenodon and crocodiles.—Mr. C. Tate **Regan** contributed a paper entitled "A Revision of the Fishes of the Genus Triacanthus," in which seven species were described, one of them, *T. indicus*, being new to science.—Mr. G. A. **Boulenger**, F.R.S., read a paper on the geographical variations of the sand-viper (*Vipera ammodytes*), in which he distinguished a geographical race (var. *meridionalis*) from Greece, the Archipelago and Syria, from the typical form found in Austria-Hungary and Bosnia.—Mr. F. G. **Parsons** read an account, drawn up by Mr. George Candler, of the habits of the hoolock (*Hylobates hoolock*), as observed by him in the forests of Cachar, in north-east India.

MANCHESTER.

Literary and Philosophical Society, February 3.—Mr. Charles Bailey, president, in the chair.—Prof. Osborne **Reynolds**, F.R.S., exhibited and explained some models illustrating his mechanical theory of the structure of the universe, propounded in his paper on the submechanics of the universe, read before the Royal Society.—Mr. C. E. **Stromeyer** read a paper on parallax determinations by photography, in which he dealt with the advantages photography offers for rapid and accurate surveys. The principle recommended was to superimpose the image of a photographic negative taken at one position on the image of a photographic positive taken at another position, the parallax, or angle which separates two positions as seen from any of the objects in the photographs, being measured micrometrically by shifting one of the images until the object registers and disappears. It was suggested that the best results would be obtained by placing the two photographs in two lanterns and superimposing the images on a screen or into a microscope eyepiece, but the instrument shown was arranged to suit a single lantern, the negative and the positive being placed film to film.—Mr. W. B. **Baron** read a paper (communicated by Mr. Stromeyer) on the influence of hydrogen in fuel on the composition of the resulting flue gases. He showed that by making the gas analysis, usually undertaken in boiler trials, with little more than ordinary care, and applying various corrections thereto, the relation of hydrogen to other combustible in the fuel can be accurately found.

DUBLIN.

Royal Dublin Society, February 17.—Pro.. J. Joly, F.R.S., in the chair.—Dr. G. Johnstone **Stoney**, F.R.S., read a paper entitled "How to Introduce Order in the Relations between British Weights and Measures." The paper describes a proposal for legislation which the author submitted two years ago to the Board of Trade. Its aim is to get rid of the irrationality between the two methods of measurement, without its being necessary for Parliament to call upon the inhabitants of this country to make any change in their habits of thought, or the practice to which they are accustomed, until they themselves choose to do so. The main parts of the proposal are that an Act be passed making the yard exactly nine-tenths of the metre, the avoirdupois pound exactly nine-tenths of the metric pound or half kilogram, and the imperial gallon exactly nine-tenths of the metric gallon or half dekalitre. They at present differ from these amounts by small but very troublesome fractions.—Mr. David **Houston** communicated a paper on the value of bacteriological tests in judging the butter exhibited at agricultural shows. The author had submitted all the butter exhibits that had gained prizes at the Society's winter show at Ball's Bridge to a detailed bacteriological examination, and had also visited many of the contributing creameries with the object of checking laboratory results. The experiments, it was claimed, proved the fallacy of ordinary methods of judging the quality of butter, and demonstrated the utility of bacteriological tests, at least as an auxiliary to the usual method, in determining the real value of butter.—Mr. G. H. **Carpenter** read a paper on injurious insects and other animals observed in Ireland during the year 1902. The most important records were the flour moth (*Ephestia Kuehniella*) in Belfast Mills, and a new species of Australian weevil (*Syagrius intrudens*, Waterh.) as a greenhouse pest in the Royal Botanic Gardens, Glasnevin. Mention was also made of the injury to various vegetable stems and roots by Enchytræid worms.—Dr. Henry H. **Dixon** presented two criticisms on the cohesion theory of the ascent of sap. In this paper Steinbrinck's objection, based on the permeability of the walls of the conducting tubes to air, is shown to be invalid. Air passing through the wet walls must be in solution, and it has been shown by experiment that saturation of water by air does not appreciably lessen its tensile strength. Secondly, Copeland's criticism, founded on experiments made with plaster of Paris, is shown to involve perpetual motion. The true explanation of Copeland's results is to be found in the continued absorption of plaster of Paris after setting, combined with its great resistance to the passage of water.

PARIS.

Academy of Sciences, February 23.—M. Albert Gaudry in the chair.—The law of electromotive forces in saline solutions: the influence of temperature, by M. **Berthelot**.—On tuberculosis and diaphysis of the long bones of the limbs and its treatment, by M. **Lannelongue**. If the tuberculous abscess or tuberculome is not too large, a cure may be effected by a simple washing with an antiseptic liquid containing iodoform, creosote, ether and olive oil. In more severe cases the abscess must be opened, and the whole of the inside surface scraped with a cuvette. If due care is taken, the abscess is not liable to recur.—The action of a polarised bundle of very refrangible radiations on very small electric sparks, by M. R. **Blondlot**. The action of the X-rays from a focus tube upon an electric spark has shown that these rays are polarised; it appeared to be of interest to see if a similar action could be traced in the case of a bundle of polarised light rays. The whole of the experiments described show that a bundle of polarised light rays produces a notable reinforcement of the spark when its plane of polarisation is normal to the spark, and does not act on it when its plane of polarisation is parallel to it; in other words, there is a plane of action of polarised light upon the small spark, and this plane is normal to the plane of polarisation.—Prof. Koch was elected a foreign associate in the place of the late Prof. Virchow.—On a particular class of triple orthogonal systems, by M. C. **Guichard**.—On the resistance of perfect gases to the movement of solids, by M. L. **Jacob**.—A hydro-tachymeter for regulating hydraulic turbines, by M. L. **Ribourt**. The new form of governor, a description of which with drawings is given, has worked very satisfactorily in practice. In that form of turbine most difficult to regulate, small power with a low fall, the variations of velocity have been kept constant within 2 per cent., although the variations of resistance amounted to 30 per cent.—The variations in the modulus of elasticity in nickel steels, by M. C. E. **Guillaume**. The method employed consisted in observing at different temperatures a chronometer furnished with a spiral of the alloy under examination mounted on a brass balance. Alloys containing 26 per cent. and 45 per cent. of nickel possessed the smallest temperature coefficient.—On the spontaneous reduction of the amount of carbon in steel, by M. G. **Belloc**. The sudden heating of a hard steel wire spiral in a vacuum gives a greyish metal, soft and incapable of being tempered. This effect appears to be intimately connected with the presence of occluded gases, since it is not produced if occluded gases are absent.—On the influence of certain modes of treatment on the microscopic structure of certain nickel steels, by M. Léon **Guillet**. Micrographic observations show the effects of tempering, annealing and hammering on nickel steels more clearly than mechanical tests, and in shorter time.—On the products of reduction of copper salts by hydroxylamine, by M. E. **Péchard**. An ammoniacal solution of copper sulphate is decolorised by sulphate of hydroxylamine, nitrogen and nitrous oxide being evolved. From an ammoniacal solution of copper acetate cuprous acetate can be readily obtained by hydroxylamine sulphate.—The action of urea upon pyruvic acid, by M. L. J. **Simon**.—On some phosphorus derivatives of benzophenone and

methyl-propyl-ketone, by M. C. **Marie.** The phosphorus compounds described were obtained by heating together hypophosphorous acid and various ketones.—On the results obtained in the distillery by the application of yeasts acclimatised to the volatile toxic principles present in the molasses from beetroot, by M. Henri **Alliot.** Satisfactory results have been obtained in practice by the use of acclimatised yeasts, the alcoholic fermentation taking place in a liquid not only containing substances detrimental to yeasts, but also contaminated with foreign bacteria.—Experimental researches on epithelial hyperplasia and on the transformation of epithelium into conjunctive tissue, by M. Ed. **Retterer.** The irritation which produces on the epidermis the loosening of the skin gives rise to evolutive phenomena which recall very nearly those of cartilage in the course of ossification. The cells proliferate and give rise to new cells, which are transformed into reticular and vascular conjunctive tissue.—The series of the genus Absidia, by M. Paul **Vuillemin.**—On the interpretation of the arrangement of the bundles in the petiole and leaf veins of the dicotyledons, by M. **Col.**—Eruptions of the secondary period in the Island of Crete, by M. L. **Cayeux.** The eruptive rocks in Crete form a part of the strata which have been identified with the Upper Jurassic. The eruptive rocks have metamorphosed the upper strata in which they are included, and leave absolutely untouched the more recent strata.—The lower Devonian in the region of Kosva (Northern Ural), by MM. L. **Duparc,** L. **Mrazec** and F. **Pearce.**—On the faults at Poitou, between Parthenay, Niort and Poitiers, by M. Jules **Welsch.**

DIARY OF SOCIETIES.

THURSDAY, MARCH 5.

ROYAL SOCIETY, at 4.30.—The Resistance of the Ions and the Mechanical Friction of the Solvent: Prof. F. Kohlrausch, For. Mem. R.S.—The Electrical Conductivity of Solutions at the Freezing Point of Water: W. C. D. Whetham, F.R.S.—A Note on a Form of Magnetic Detector for Hertzian Waves adapted for Quantitative Work: Prof. J. A. Fleming, F.R.S.—On the Laws Governing Electric Discharges in Gases at Low Pressures. Communicated by Prof. J. J. Thomson, F.R.S.: W. R. Carr.—The Differential Invariants of a Surface, and their Geometric Significance: Prof. A. R. Forsyth, F.R.S.

ROYAL INSTITUTION, at 5.—Insect Contrivances: Prof. L. C. Miall, F.R.S.

SOCIETY OF PUBLIC ANALYSTS, at 8.

CHEMICAL SOCIETY, at 8.—The Mechanism of the Reduction of Potassium Bichromate by Sulphurous Acid: H. Bassett.—The Constitution of Pilocarpine. Part IV.: H. A. D. Jowett.—Preparation and Properties of 1 : 4 (or 1 : 5)-Dimethyl Glyoxaline and 1 : 3-Dimethyl Pyrazole: H. A. D. Jowett and C. E. Potter.—Some Analyses of "Reh," or the Alkaline Salts in Indian Usar Land: E. G. Hill.—Experiments on the Synthesis of Camphoric Acid. Part III. Synthesis of Isolauronolic Acid: W. H. Perkin, Jun., and J. F. Thorpe.—Camphor-β-thiol: T. M. Lowry and G. C. Donington.—Isomeric Change of Dibenzanilide into Benzoyl-*o*-amino- and Benzoyl-*p*-amino-benzophenone: F. D. Chattaway.—The Rate of Decomposition of Diazo-compounds. Part III. The Temperature Coefficient: J. C. Cain and F. Nicoll.

LINNEAN SOCIETY, at 8.—On some Points in the Visceral Anatomy of the Characinidæ: W. S.-Rowntree.—On the Anatomy of the Pig-footed Bandicoot *Chaeropus castanotis*: F. G. Parsons.—Further Notes on Lemurs: Dr. Elliot Smith.

RÖNTGEN SOCIETY, at 8.30.—Spark Phenomena: F. H. Glew.

FRIDAY, MARCH 6.

ROYAL INSTITUTION, at 9.—Studies in Experimental Phonetics; Prof. J. G. McKendrick, F.R.S.

GEOLOGISTS' ASSOCIATION, at 8.—The Pliocene Bone Bed of Concud, Teruel, Spain: Dr. A. Smith Woodward, F.R.S.—On the Zones of the Upper Chalk in Suffolk: A. J. Jukes-Browne.

SATURDAY, MARCH 7.

ROYAL INSTITUTION, at 3.—Light: Its Origin and Nature: Lord Rayleigh.

MONDAY, MARCH 9.

SOCIETY OF ARTS, at 8.—Hertzian Wave Telegraphy in Theory and Practice: Prof. J. A. Fleming, F.R.S.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—A Buried Landscape in the English Midlands: Prof. W. W. Watts.

TUESDAY, MARCH 10.

ROYAL INSTITUTION, at 5.—Recent Advances in Photographic Science: Sir William Abney, K.C.B.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Recent Irrigation in the Punjab: S. Preston.—The Irrigation Weir across the Bhadar River, Kathiawar: J. J. B. Benson.

WEDNESDAY, MARCH 11.

SOCIETY OF ARTS, at 8.—Existing Laws, By-Laws and Regulations relating to Protection from Fire, with Criticisms and Suggestions: T. Brice Phillips.

GEOLOGICAL SOCIETY, at 8.—Petrological Notes on Rocks from Southern Abyssinia collected by Dr. R. Koettlitz: Dr. Catherine A. Raisin.—The Overthrust Torridonian Rocks of the Isle of Rum and the Associated Gneisses: Alfred Harker, F.R.S.

THURSDAY, MARCH 12.

ROYAL SOCIETY, at 4.30.—*Probable Papers*:—On the Histology of *Uredo dispersa*, Erikks., and the "*Mycoplasm*" Hypothesis: Prof. Marshall Ward, F.R.S.—A Study of a Unicellular Green Alga, occurring in Polluted Water, with especial Reference to its Nitrogenous Metabolism: Miss H. Chick.—A Comparative Study of the Grey and White Matter of the Motor Cell Groups and of the Spinal Accessory Nerve in the Spinal Cord of the Porpoise (*Phocæna communis*): Dr. D. Hepburn and Dr. D. Waterston.—The Oestrous Cycle and the Formation of the Corpus Luteum in the Sheep: F. H. A. Marshall.—On the Culture of the Nitroso-bacterium: H. S. Fremlin.—Upon the Immunising Effects of the Intracellular Contents of the Typhoid Bacillus as Obtained by the Disintegration of the Organism at the Temperature of Liquid Air: Dr. A. Macfadyen.

ROYAL INSTITUTION, at 5.—Insect Contrivances: Prof. L. C. Miall, F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Distribution Losses in Electric Supply Systems: A. D. Constable and E. Fawssett.—A Study of the Phenomenon of Resonance in Electric Circuits by the Aid of Oscillograms (abstract): M. B. Field.

SOCIETY OF ARTS, at 4.30.—The Currency Policy of India: J. Barr Robertson.

MATHEMATICAL SOCIETY, at 5.30.—On the Convergence of Certain Multiple Series: G. H. Hardy.—On the Representation of a Group of Finite Order as an Irreducible Group of Linear Substitutions and the Direct Establishment of the Relations between the Group-Characteristics: Prof. W. Burnside.—Approximate Calculation of the Periods of Vibration of a Circular Plate: Prof. H. Lamb.—Mathematical Notes: Dr. H. F. Baker.

FRIDAY, MARCH 13.

ROYAL INSTITUTION, at 9.—Character Reading from External Signs; Prof. Karl Pearson, F.R.S.

PHYSICAL SOCIETY, at 5.—On the Interpretation of Milne Seismograms: Dr. Farr.—A Potentiometer for Thermocouple Measurements: Dr. R. A. Lehfeldt.—A Direct-Reading Potentiometer for Thermoelectric Work: Dr. J. A. Harker.—The Measurement of Small Resistances: A. Campbell.—A Resistance Comparator: Dr. R. A. Lehfeldt.

MALACOLOGICAL SOCIETY, at 8.—Further Description of the Animal of *Damayantia carinata*, Collinge: Lieut.-Col. H. H. Godwin-Austen, F.R.S.—Note on the Generic Name Buliminus: B. B. Woodward.—Notes on Pleistocene Non-marine Mollusca from Portland Bill; and on Holocene Non-marine Mollusca from Wilts, Dorset Cambridgeshire and Folkestone: R. Ashington Bullen.—On the Occurrence of *Neritina Grateloupiana*, Fér., in the Pleistocene at Swanscomb: A. S. Kennard and B. B. Woodward.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Reconstruction of Midland Railway Bridge No. 27, over the the River Trent: A. R. Langton.

SATURDAY, MARCH 14.

ROYAL INSTITUTION, at 3.—Light: Its Origin and Nature: Lord Rayleigh.

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