

THURSDAY, APRIL 5, 1906.

IONS, ELECTRONS, AND CORPUSCLES.

Les Quantités élémentaires d'Électricité: Ions, Électrons, Corpuscles. Mémoires réunis et publiés par Henri Abraham et Paul Langevin. Two volumes. Pp. xvi+1138. (Paris: Gauthier-Villars et Fils, 1905.) Price 35 francs.

THIS very important work, which has been brought out by the French Physical Society under the joint editorship of MM. Abraham and Langevin, consists of a series of digests of the memoirs on which the foundation of the electrodynamic theory of matter is laid. In some cases *résumés* of their researches have been written especially for this work by the original authors, but in the majority of instances the papers have been dealt with by abstractors. The value of this method depends entirely on the insight which is brought to bear upon it, and the task must have been particularly difficult in the present instance owing to the great variety of the material concerned, since many of the investigations are purely experimental, whilst others require all the skill in abstract reasoning possessed by the pure mathematician. The excellence which we should expect from the names of the editors, one of whom, M. Langevin, has himself made extensive and valuable contributions to the subject, is completely justified by the result. Whenever it was consistent with the necessary brevity, the abstractors have kept to the original words of the author, and, so far as the reviewer has been able to discover, no author can claim that his views have been misrepresented in any important particular.

The book will be heartily welcomed by all who are interested in the development of the electron theory, whether it be in its most general aspect as a fundamental theory of physical phenomena or in its extremely interesting applications to such complex branches of the subject as the conduction of electricity through gases and radio-activity. It is true that we have a number of books, such as J. J. Thomson's "Conduction of Electricity through Gases" and "Electricity and Matter," Larmor's "Æther and Matter," Poincaré's "Électricité et Optique," Stark's "Die Elektrizität in Gasen," and Rutherford's "Radio-activity," which in one way or another contain the whole of the material of the two volumes under review; but in these cases the material has usually been selected, often, of course, with gain of interest, so as to emphasise the point of view of the particular author. In the present work, on the contrary, we are furnished with an account of each portion of the subject as it developed itself in the mind of its discoverer. The work therefore fills a distinct lacuna in the literature of the subject.

Recent advances in electrodynamics have placed the fundamental principles of physics in an interesting but not altogether satisfactory position. By considering the energy of the electric field, J. J. Thomson showed, many years ago, that a moving electric charge possessed a spurious mass due to the disturb-

ance it created in the ether through which it was moving. This idea has been more than confirmed by the experiments of Kaufmann on the mass of the Becquerel rays or negative electrons. These experiments show that the *whole* of the mass of these electrons is of electrical origin, and is due entirely to the motion of their electric charges. The work of Lorentz and Larmor has given very good reasons for supposing that all matter consists solely of electrons, so that we are forced to the conclusion that the mass of all matter is due to the electrical charges of its ultimate particles.

The reasoning by which this result has been arrived at is dynamical in character, and is therefore based on mass, space, and time as fundamental conceptions. Thus, by the application of a system of thought in which mass is a fundamental conception, we have succeeded in resolving the idea of mass into something, viz. electricity, which lies outside the system.

There appear to be two ways of escape from the confusion implied by this paradoxical result. The first is to resolve electricity into the mass motion of a mechanical ether, and thus to make everything again consistent with the fundamental laws of mechanics. Attempts to construct a dynamical theory of the ether have continually been made ever since the ether began to figure in the literature of exact science. The most successful hitherto has been that of Larmor, which made the ether a perfect fluid composed of gyrostatic atoms. According to this view, which has been criticised by Poincaré in his "Électricité et Optique," the velocity of the ether is along the lines of magnetic force. We have, however, good grounds for thinking that the drift velocity of the ether is proportional to the vector product of the electric and magnetic forces, and it is probable that the successful ether theory will furnish an explanation of this result.

The second way of escape is to take the equations of the electromagnetic field as ultimate relations which are empirically given and of which there is no "explanation." By making energy the fundamental conception, we could then obtain a consistent scheme which would not involve the idea of mass in any fundamental way. The equations of motion of any material system could then be obtained by an appropriate variation of the energy function, which of course contains only electric and magnetic terms, and the results expressed in terms of force subsequently if required. On this view the momentum in any system is obtained as the volume integral of the vector product of the electric and magnetic forces, and mass is simply the vector coefficient which results on dividing the increase in this by the corresponding increase in velocity. This method of stating the case, which makes mass a very secondary conception, will at once be recognised as our old friend the "energetic" view of things, and the electrodynamic explanation of mass may justly be regarded as a great triumph for energetics. The considerations which have been brought forward in the preceding paragraph show, however, that the solution in terms of

energy is not the only solution of the problem, and it remains for the future to decide which of the two is the more convenient and the more fundamental. The "energetic" system of physical philosophy suffers by being intangible and lacking in imaginative stimulus, whilst the material it makes use of in order to build up a picture of the phenomena of nature is not characterised by the simplicity which is desirable in relations of so ultimate a character.

Returning to the book under review, we find, naturally, that a great deal of it refers to the important investigations on the charge, mass, velocity, and other properties of ions and electrons. These have been described with that excellence which characterises the whole production. The reader will find a particularly satisfactory account of Townsend's very exact investigations on ionisation by collisions.

There is a minor point which may be criticised, and that is the prominence given to Moreau's results on the velocity of ions produced by metallic salts in flames. That investigator found that the velocity of the negative ions varied in an unexplained way with the concentration of the salt and the atomic weight of the metal, whereas H. A. Wilson found it to be independent of both these factors. The editors appear to have overlooked the experiments on this subject of the last-named author.

With this slight exception, we have nothing but praise for the whole work, and heartily congratulate the French Physical Society and all who have been concerned in its production. We hope that they will be able to bring out more volumes of a like kind as the development of the subject proceeds. It will be remembered that a few years ago the French Physical Society published a very important series of memoirs, on all branches of physics, which had been communicated to the International Congress at Paris in 1900. The extraordinary activity of the society in this way must command the admiration and gratitude of physicists in every part of the world.

O. W. RICHARDSON.

ANOTHER PLEA FOR RATIONAL EDUCATION.

On Professional Education, with Special Reference to Medicine. An Address delivered at King's College, London, on October 3, 1905. By Prof. T. Clifford Allbutt, F.R.S. Pp. vi+80. (London: Macmillan and Co., Ltd., 1906.) Price 2s. net.

"**T**HREE is no state so perilous as that in which things seem good to us, and at present in England the schoolmaster is complacent, the public indifferent." So Prof. Allbutt generalises early in his address, directing attention, however, in a footnote, to a single exception in the case of the headmaster of the Perse School, Cambridge. Though many more earnest schoolmasters anxious to reform scholastic methods could be named, thoughtful observers of English educational procedure must admit—in spite of the current bickerings among politicians as to religious instruction in elementary schools—that the schoolmaster's policy of *laissez-aller* and the apathy

of the public are, and have been, the chief causes of the chaotic and rudimentary state of our secondary education. For half a century it has been dinned into the ears of statesmen, parents, and schoolmasters that no system of higher education, whether academic or technical, can prove successful in the absence of a sane, modern, and broad supply of secondary education given by rationally trained teachers. Prof. Allbutt is to be congratulated upon ranging himself on the side of the prophets, and though for the present he may be a voice crying in the wilderness, his able advocacy of the introduction of sweet reasonableness into our secondary schools will some day be counted unto him for righteousness.

A few of Prof. Allbutt's lessons to the schoolmaster may be quoted with advantage. "The scientific study of facts is the lever by which liberal culture has been re-awakened, and we are beginning to see that the ideas and methods of natural science, instead of being merely curious or commercial, are, if not the flower of education, at any rate the stem and branches." "On both 'sides' [of most schools], while the memory is exercised, and the intellect somewhat called upon, the imagination, the centre of creative life, the source of great action, is left out in the cold." The teacher who fears the baneful effects of specialisation may note this:—"I am satisfied that if the two main coefficients of mind—the intellect and the imagination—are fostered, it proves best in the end to promote development in each person on the lines of his own nature." But we have kept what in our judgment is the most important quotation—trite though the advice is—to the last:—"It is not so much *what* a man is taught as *how* he is taught it."

This advice leads naturally to the consideration of the present secondary school curriculum. Not every essential part of a wide subject can be included in a single address, but it is to be regretted that Prof. Allbutt has so little to say on the simplification and lightening of the absurdly congested time-tables of most schools. It is true that we are told that the current teaching of Greek and Latin is a parody of education, and that, like Sir William Ramsay, Dr. Allbutt considers chemistry is not a good subject for boys, but some guidance in the direction of a ruthless cutting down of the number of subjects at present studied by young boys would have been welcome. It is in this direction that the schoolmaster has a right to look to the man of science for guidance. Cannot physiologists and psychologists agree together as to what groups of faculties should be trained during the years of school-life, and, with the help of pedagogical experts, decide which groups of subjects best assist such training? Until this is done, or until some masterful genius filled with the pedagogic passion arises who will solve this most pressing of educational problems, secondary education will continue to be a process of filling the minds of boys and girls with pellets of information in a multitude of subjects, and of loading the verbal memory with a brecciated congeries of unrelated facts.

On the tertiary, or university, stage of education

Prof. Allbutt speaks with authority and full knowledge. He points out to the medical student who through comparative indigence has to proceed from the secondary to the medical school without the initiatory university course with which his more opulent contemporary is favoured, that "there is no difficulty, at any rate in university education, in using for general training the broader principles of any one of the professional faculties." Applying his principle already quoted, that it is not what is taught but how it is taught, Dr. Allbutt shows how professional studies may be made sources of culture and broad ideas by the non-university medical student. But there is in no sense a disparagement of the unique value of a good university course, with its chances of intercourse with many types of intellect and the opportunities the student has of learning the best which has been done and said in the world.

The question of examiners and examinations is dealt with also. We are told that "the professional examiner, he who makes it his business to range from place to place imposing mechanical tests wholesale, is one of the new terrors of life." We are not introduced, however, to the evil effects of examinations upon the examiners. The examiners are, in many cases, distinguished men of science who eke out insufficient emoluments by undertaking examining work in their leisure hours—time which, in a rationally organised system that recognised the workman to be worthy of his hire, would be devoted to research work. Enough has been heard of the evil effects of examinations upon students, and, indeed, much has been done in the direction of judicious inspection to remedy these, and it is time to recognise that the employment of eminent leaders in science to do the work which competent teachers can perform better is an improvident use of our best intellects.

We notice, in conclusion, that Prof. Allbutt sums up the end of education to be action. "We learn, that we may do," he says. The educated man must not rest satisfied with his education, and be content selfishly to enjoy the intellectual gratifications placed at his disposal. Like each one of us, the educated man is one member of a complex society with many needs to be satisfied, many abuses to be swept away, many wrongs to be redressed. The privileges the educated man has enjoyed, and the sources of satisfaction his education has revealed to him, should serve as incentives urging him to work for the advancement of his race and the further development of human society.

A. T. S.

A MARE'S NEST.

The Utilisation of Nitrogen in Air by Plants. By T. Jamieson. Pp. 82+18. (Aberdeen: The Agricultural Research Association, 1905.)

MATTHEW ARNOLD has somewhere a finely ironical passage in which he comments upon the British habit of labelling its institutions with a great name without considering whether they possess any great thing to correspond, and certainly the name of "Research" has rarely been more taken in vain

than in the present publication. The Agricultural Research Association appears to be a body of gentlemen in the neighbourhood of Aberdeen who maintain certain experimental plots under the direction of Mr. T. Jamieson. It is further assisted by grants from the County Council and from the Board of Agriculture, and it has issued the above report for 1905, heralded by some startling preliminary trumpets in the Scottish Press. Briefly speaking, Mr. Jamieson claims to have "discovered" "that plants generally absorb free nitrogen directly from the air, and transform it into albumen." He proposes to wipe out agricultural science between the dates of De Saussure and himself, writing, indeed, with a curious resemblance to the amateur speculations of sixty years ago.

Mr. Jamieson begins by demolishing, to his own satisfaction, the theory that leguminous plants fix nitrogen by the agency of bacteria, and the quality of his argument may be gauged from the following passage:—"It should be borne in mind, also, that bacteria were *never proved to be present*. The small particles found in the tubercles were merely *assumed* to be bacteria." What are we to say to a man who proposes to dismiss the nineteen years' work of some scores of investigators in every country by denying a fact he could demonstrate to himself at any moment had he the most elementary acquaintance with the manipulation of bacteria? But no; Mr. Jamieson prefers to speculate on his own, without even reading up the subject. There is a curious footnote on p. 29 which, we imagine, is meant to display Mr. Jamieson's acquaintance with the literature of nitrogen fixation; a list of authorities is given, equally amazing as regards either its inclusions, its omissions, or its spellings of proper names. Beyerinck appears variously as Burginck and Beirjerenck. But when we leave Mr. Jamieson's criticism and turn to his constructive work the result is even more amazing. He takes an ordinary plant, spurrey, for example, and finds certain hairs on the leaves. To ascertain the purpose of these hairs he applies to them iodine or some other reagent capable of staining proteid. He finds that the tips of these hairs, which are at first empty and then become green with chlorophyll, give later a reaction for albumen, which disappears again as the hairs age. "If the formation of albumen takes place in the tip of this hair, one would expect to find its absence in the early stage, its presence in the later or active stage, its discharge through the channels and round the cells of the plant, and its possible absence in the latest stages—and this is what has actually been found."

"The evidence that nitrogen is absorbed by these tips, and is there fixed and manufactured into albumen, is thus as complete as could well be desired." "The direct absorption of nitrogen, and its direct fixation as albumen, thus seems demonstrated even more satisfactorily than is possible by chemical analysis," and none, accordingly, is attempted. " 'Tis safer so," as the American poet puts it. Mr. Jamieson does not bring forward a single experiment to demonstrate that nitrogen has been fixed by any of his plants; this fundamental fact (?) he assumes.

The fact that many investigators like Boussingault and Lawes and Gilbert found no fixation of nitrogen during the growth of plants Mr. Jamieson dismisses on the ground that the plants under experiment had not attained their normal vigour, forgetting that Lawes and Gilbert had dealt with and dismissed this very point in their field experiments upon root crops. Mr. Jamieson even argues that the growth of the leafy turnip crop with small or no nitrogenous dressings implies that the crop has drawn its nitrogen from the atmosphere, whereas this is the standard example in the lecture-room of how the great reserves of nitrogen in the soil can be made to feed the plant if nitrification be promoted by the frequent cultivations and the high soil temperatures which characterise the growth of the turnip crop.

It is on this sort of foundation that Mr. Jamieson proposes to re-build the whole edifice of agricultural science; really the thing would be amusing were it not so dangerous and discreditable to the cause of scientific research. Mr. Jamieson has a following. Putting aside his official backing, and the dukes, earls, and marquises who figure as patrons, there is a body of solid farmers and landowners who sit under him and take advice on practical matters which they suppose to represent the last word of science. Accustomed to the amenities of theological disputation, these men like their agricultural science in the same style; not the dry light of reason, but a strenuous assertion of a monopoly of the truth, rhetoric and passion, and a vigorous denunciation of the other side—all these they get from Mr. Jamieson. But it is a windy diet, and sooner or later disagrees with the subject, whereupon science gets the blame.

A. D. H.

OUR BOOK SHELF.

Technical Methods of Ore Analysis. By A. H. Low. Pp. x+273. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1905.)

This book is of interest as showing the exact methods of analysis of ores in use in the United States at the present time. The author is a member of a well known and old-established firm of analysts and assayers in Denver whose results are accepted with respect by miners and smelters in the western States. It is unusual for such a man to publish exact descriptions of the methods used in his office, as any discoverable flaw in a method might be seized on and magnified by his rivals with prejudicial results to his business. Now that Mr. Low has shown so much courage, his example may be followed.

The book contains detailed descriptions of the estimation of the ordinary constituents of ores, omitting all "fire methods" of assay. The details are minute enough to be tiresome in reading the book through, the account of the precautions to be taken in volumetric analysis, for example, being repeated whenever a volumetric method is reached. In this swarm of details the salient points of the methods are lost, and as the headings are somewhat vague, careful search is necessary to find out what method is being described. An analyst must generally read the whole of a section if he wishes to refresh his memory on some particular point, and will count himself fortunate if he has hit on the right section. Nevertheless, the point will probably be in the book, to be discovered by perseverance.

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The methods are usually good and carefully described. It seems a pity that Mr. Low should designate the determination of zinc by ferrocyanide the "author's method," without referring to Galetti or Fahlberg, to whom he is indebted for so much, but there is probably no intention to deceive. Also, in the estimation of copper by iodide, the practice of adding a solution of potassium iodide, instead of crystals, is recommended without any warning as to the decomposition of the solution if it is kept for some time. However, the book is generally trustworthy and useful. There is no book like it, and the analyst will naturally have a copy on his shelf.

The Lepidoptera of the British Islands. A Descriptive Account of the Families, Genera, and Species Indigenous to Great Britain and Ireland, their Preparatory States, Habits, and Localities. By Charles G. Barrett, Vol. x. Pp. 384. Heterocera: Pyralidina—Tortricina. (London: Lovell Reeve and Co., Ltd., 1905.)

SINCE our notice of the last volume of this work entomologists have to regret the death of the accomplished author, well known as one of the best practical lepidopterists in England long before he commenced the elaborate monograph which he did not live to complete. Hitherto, however, there has been no interruption in the publication of the successive parts, and we understand that the manuscript was left practically complete to the end of the Tortricina, which is the more satisfactory as the Tortricina are a large and difficult group which have been somewhat neglected by most British lepidopterists, but to which Mr. Barrett devoted special attention.

The families included in vol. x. are Pyralidina; Phycitidae (conclusion), 13 genera (Cateremna to Plodia); Anerastiidae (genus Anerastia), Crambidae (6 genera), Galeridae (5 genera), Tortricina, Tortricidae (17 genera), Cnephasiidae (5 genera), Lozoperidae (7 genera), Sercoridae (commencement, 4 genera).

The general arrangement of the present volume is similar to that employed in preceding volumes, and the remarks on the habits of the insects are detailed and interesting. For example, we are told that the first species in the volume (*Cateremna terebrella*, Zinck.) has a curious habit of emerging during thunderstorms, these being, as is well known, frequent in the eastern counties. The history of the various species, small and inconspicuous as many of them are, is very fully given throughout.

W. F. K.

A First Reader in Health and Temperance. By W. Taylor. Pp. iv+219. (London, Westminster: Church of England Temperance Society and G. Philip and Son, Ltd., n.d.) Price 1s. 6d.

In this small book the instruction is given in forty-three lessons wherein all difficult words are avoided so far as possible, and when such words are necessary their meaning is always explained. The elementary matter dealt with is suitably illustrated, and the work is in every respect to be commended.

The various physiological requirements of the body are explained in simple language, and it is shown that alcohol is not only unnecessary but may be actually detrimental to every healthy function. Abstention from alcohol is, in fact, the dominant text of the book.

It is not easy to conceive a book better suited to meet the needs for which it is designed. The subject of personal hygiene is made interesting and it is treated in a very happy and lucid manner, appropriate to the intellectual powers of young children, for whom the book is designed to serve as a first reader.

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.]

Spectral Series in Relation to Ions.

As I have already shown (*Physik. Zeitschr.*, vi., 892, 1905), the observation of the Doppler effect on the Kanalstrahlen permits the detection of spectra emitted by the positive ions (Kanalstrahlen). I have made such researches on Kanalstrahlen in hydrogen, potassium vapour, and mercury vapour in cooperation with Messrs. S. Kinoshita, K. Siegl, and W. Hermann. We shall give details of our methods and measurements in separate papers; but here I wish to state the principal results of the researches, together with some general conclusions.

The series of lines ($H\alpha$, $H\beta$. .) of hydrogen is a first subordinate series. Its lines are revealed by accurate analysis as pairs or doublets. The difference of wavelengths of the two components is, as Michelson has found (*Phil. Mag.*, xxxiv., 280, 1892), 0.14 Ångström unit for $H\alpha$ and 0.08 Ångström unit for $H\beta$; the measurements made by Ebert (*Wied. Ann.*, xliii., 790, 1891) give 0.132 Ångström unit for $H\alpha$. In every other first subordinate series of doublets, and also in the case of hydrogen, the difference in oscillation frequencies of the components of the doublet is constant throughout the series; this difference is for $H\alpha$ 0.33, for $H\beta$ 0.34 per 1 cm. path *in vacuo*. My previous and recent observations lead to the conclusion that the first subordinate series of doublets of hydrogen has as carriers monovalent positive atom-ions, *i.e.* atoms of hydrogen which have lost a single negative electron.

A second subordinate series of lines of the hydrogen has been observed in certain stars. From their spectral position, Rydberg (*Astrophys. Journ.*, vi., 233, 1897) has calculated the principal series of hydrogen; he gives to the first line of it the wave-length 4687.88 Ångström; this line has been observed in stars with bright lines. It is found also (somewhat displaced) in all spectrograms I have taken of the cathode rays or Kanalstrahlen, partly alone and partly in cooperation with Mr. Kinoshita. This line of the principal series—it may be termed $H\beta$ —shows also the Doppler effect in the Kanalstrahlen, the quantity of the effect being the same as for the first subordinate series of doublets; the principal series of the hydrogen, which is also composed probably of doublets, has therefore the same carrier as the first subordinate series, namely, the monovalent positive ion of hydrogen.

In cooperation with Mr. Siegl I have further examined another doublet of a principal series, namely, the second doublet of the principal series of potassium (λ 4047.36-4044.29). Both components show the Doppler effect in the Kanalstrahlen, and the amount is the same as that calculated for an atom of potassium which has lost a single negative electron. Therefore, in the case of the alkali-metals also, the principal series of doublets has monovalent positive ions as carriers.

In the spectrum of mercury hitherto only series of triplets have been found—a first and a second subordinate series (Kayser and Runge). Using a small concave grating kindly lent to me by Prof. Runge, I succeeded, in cooperation with Mr. Hermann, in examining the Doppler effect on the lines of mercury. It was found that all components of triplets, and further all triplets of a series, have the same positive ion as carrier, and, moreover, the lines of the first and of the second series show the same Doppler effect in type and quantity. Both series of triplets of mercury have therefore the same carrier, the bivalent positive ion of mercury; for the Doppler effect really found agrees in quantity with the effect calculated theoretically for an atom of mercury which has lost two negative electrons.

The lines of mercury not belonging to the series of triplets show likewise a Doppler effect, but there is a

difference in character and amount between them and the lines of the two series of triplets. There are lines which show a larger effect than the series of triplets; the carrier of these lines is therefore a positive ion of mercury of higher valency, *i.e.* an atom of mercury which has lost more than two negative electrons. To these lines of higher valency belongs the line λ 4078.1.

Finally, there are lines in the spectrum of mercury which show a smaller Doppler effect than the lines of the series of triplets; their displacement is roughly 1.5 times smaller than that of a line of a triplet of equal wave-length. Therefore they have as carrier not a bivalent, but a monovalent positive ion of mercury. To these lines belong the wave-lengths $\lambda\lambda$ 2536.72, 4339.47-3021.64, 3984.08-2847.85. It seems that λ 2536.72 is the first component of a principal series of doublets, that the pair $\lambda\lambda$ 4339.47-3021.64 belongs to a first, and the pair $\lambda\lambda$ 3984.08-2847.85 to a second subordinate series of doublets. This being so, mercury confirms the view that the principal and the first and second subordinate series of doublets have monovalent positive ions as carriers.

Generalising the foregoing results, we have come to the following conclusions:—The carriers of the spectra of lines of the chemical elements are positive atom-ions. All lines of a series have the same carrier, and, moreover, the same carrier may emit several series at the same time. The carrier of the principal series and of the subordinate series of doublets is a monovalent positive atom-ion; the carrier of the subordinate series of triplets is a bivalent positive atom-ion; ions of a higher valency emit likewise line-spectra, but the structure of these is not yet recognised. The spectrum of an element, for example, that of mercury, may represent a mixture of several spectra, namely, of the spectra of its monovalent, bivalent ions, and of ions of higher valency.

The foregoing results and conclusions are in striking agreement with the results which were arrived at by Runge and Paschen (*Ber. d. Berliner Akad.*, 1902, 380, 720) in their researches on the Zeeman effect of series of lines. They found that the principal series of doublets of all elements examined (Na, Cu, Ag, Mg, Ca, Sr, Ba) show in type and amount, when measured in oscillation frequencies, the same Zeeman effect; this also holds good for the first and the second series of doublets. The first and second subordinate series of triplets show in type and amount another Zeeman effect than the series of doublets; but the series of triplets of different elements are again in the same way broken up by a magnetic field. The agreement of my results with those of Runge and Paschen comes out in the following detail:—The lines of mercury ($\lambda\lambda$ 2536.72, 4339.47, and 2847.85) referred by me to series of doublets must show in a magnetic field the known splitting up of the lines of the principal and of the subordinate series of doublets. Runge and Paschen enumerate these lines under those which do not show the behaviour of triplets, and, in fact, their statements on the magnetic behaviour of those lines are concordant with that postulate.

It follows from the Zeeman effect that the centres of emission of series of lines are periodically accelerated negative electrons. From the complexity of their magnetic splitting up we may draw the conclusion that these centres of emission—the negative electrons—are coupled in electrodynamic systems; the electrodynamic structure of these systems of negative electrons is for the emission of series of doublets rather than for the emission of series of triplets.

We do not know of spectra of neutral atoms. It follows from the foregoing results that the known spectra of lines can only be emitted if the chemical neutral atoms have lost negative electrons, and thus have become positive atom-ions. Therefore the electrodynamic symmetry of the system of negative electrons in the positive atom-ion is different from the symmetry in the neutral atom. Certain systems of negative electrons have in the positive monovalent ion an electrodynamic symmetry which enables them to emit radiation of electromagnetic energy; this symmetry is characterised by the emission of doublets. Losing two or more negative electrons a neutral atom also gains an electrodynamic symmetry capable of radiation; but the

electrodynamic symmetry in the bivalent ion is different from that in the monovalent ion; it is characterised by the emission of triplets.

Spectroscopically the chemical elements show a uniform behaviour in a striking way. Their monovalent ions emit series of doublets of analogous structure and identical magnetic behaviour; their bivalent ions emit series of triplets likewise of analogous structure and identical magnetic behaviour. From element to element the variables are only the proportions of the spectra or the constants of the laws of the series of doublets and triplets.

Göttingen, March 5.

J. STARK.

The Kew Bulletin.

A FEW words of explanation may be useful to anyone interested in the Kew Bulletin. It was started in 1887, partly to meet a suggestion made in the House of Commons and partly to serve as "an expeditious mode of communication to the numerous correspondents of Kew in distant parts of the Empire." It has been the vehicle for the publication of a vast amount of information of various kinds, some on purely scientific, but mostly on economic subjects. The number of copies printed has necessarily been limited, but it has always been hoped that the Press would aid in the further diffusion of information of general interest to the public.

The volumes before 1892 have long been out of print. To meet this difficulty, selected papers which proved to be of permanent interest have been from time to time reprinted.

Since 1901 the Bulletin has been somewhat in abeyance, though the routine appendices which are required for various purposes have been kept up. The fact is that to produce the Bulletin satisfactorily requires—what it has never had—some sort of staff which would be specially charged with it. The volume of work which falls on Kew is little understood. Besides its own routine and administrative duties, Kew acts as technical adviser to all Government departments at home, as well as in a varying measure to India and the colonies. For many years the annual number of letters sent out has averaged about 14,000, which is about two-thirds of that of the Commercial Department of the Foreign Office. The publication of the Bulletin has simply been crowded out.

My functions as director ceased on December 15, but I was retained in a consultative capacity until March 31. In order to give my successor a clear start I have done my best in the interval to clear off arrears. The third and concluding volume of the "Index Flora Sinensis" has been issued. An eighth volume of the "Flora of Tropical Africa" has been all but passed through the press. The long delayed "Wild Fauna and Flora of the Royal Botanic Gardens" has been published. A catalogue of the exhibited collection of portraits of botanists has been prepared and is in type, and a second edition of the "Hand-list of Ferns and Fern-allies cultivated at Kew" is in the printers' hands. A third quinquennial supplement to the "Index Kewensis" is being prepared for the press.

The continuation of the "Flora Capensis" is being actively pushed forward, and other much needed undertakings are in view.

In order to restore the Bulletin to something like vitality, it was thought advisable to issue in one or more numbers for each year such matter as was available, with title and table of contents. This will allow the annual volumes to be bound, and the series made continuous to the satisfaction of careful librarians. The volumes for 1900 and 1901 are already issued, and the succeeding ones will follow immediately. A word of acknowledgment must be given to the generous aid of the new and active Controller of H.M. Stationery Office in expediting the work.

The director has taken up the publication of the Bulletin from the present year, and will, I hope, be able to continue it, but on a somewhat more elastic plan. No attempt will be made to issue it monthly, but material and documents of general interest will be printed at once.

Kew, March 30.

W. T. THISELTON-DYER.

NO. 1901, VOL. 73]

Interpretation of Meteorological Records.

I QUITE agree with Mr. Omond's remarks in NATURE of March 29 with regard to the heating of downward moving air, that if it had been simply a case of air which had previously been in thermal equilibrium and moved downwards its temperature would have been raised to that of the lower air; but in this case it was a mixture of air and water, and the water would absorb the heat produced by the compression of the air, and, further, any little heating that might not be so absorbed would increase the dryness of the air, and so cause evaporation and absorption of heat.

With regard to the effects of electricity on rainfall, they are much too little understood to be entered on here, but it may be stated that a sudden fall of rain, or an increase in rate of fall, is often observed very shortly after a flash of lightning.

JOHN AITKEN.

Ardenlea, Falkirk, N.B., March 31.

Request for Prints of Photographic Portraits.

I SHOULD be grateful to your photographic readers, whether amateur or professional, who would send me, within the next two or three weeks, waste photographic portraits, to be cut up, mounted, reduced to a miniature scale, and so to be published *without names*. They are wanted in considerable numbers to control results at which I have already arrived, relating to resemblance. Family portraits would be particularly acceptable. I make this appeal, finding it extremely troublesome, as well as costly, to obtain the needed material in other ways.

FRANCIS GALTON.

42 Rutland Gate, London, S.W.

Peculiar Ice Formation.

AS the question of earth-bearing ice-pillars has been recently raised in your columns (pp. 464, 485), there are one or two points to which I should like to direct attention, as they may be of interest to your readers. While working in company with a colleague on Divis Mountain, Belfast, in 1902, our attention was attracted by the peculiar formation of ice so admirably described by your correspondent of March 15. It seemed perfectly obvious that the ice-pillars had, in growing, lifted the earth and stones by exerting a pushing force in the direction of their length, and that without lateral support, putting the expansive force of water on freezing out of the question as an explanation. All doubt on this point was removed by our finding an impression of a nailed boot, made in the mud before the frost, and on which the pillars had grown on all parts of the mud on which there were no impressions of nails, and were wanting wherever the nails had been. This gave a curious effect, as if the boot had been shod with long spikes, each nail being represented by a narrow cylindrical pit an inch and a half deep. The pressure of the nails had evidently destroyed the conditions which led to the formation of the pillars.

I was unable to determine whether the ice in each pillar was in crystalline continuity, but there was nothing to lead one to suspect the contrary. I thought I could distinguish a rude hexagonal form in some of the pillars, but this may have been merely chance. On the whole, it would seem as if the idea that a growing crystal is capable of exerting a mechanical force in some definite direction is not entirely without support. Such a force would go far towards explaining many peculiarities of the natural growth of crystals. Take, for example, the horizontal veins of fibrous gypsum so common in the Keuper Marl. It is impossible to conceive of the formation in soft rocks of a horizontal fissure of the extent of some of these veins, and it is difficult to escape from the conclusion that the growth of the fibrous crystals forced apart the sides of the vein, lifting the enormous weight of rock above. This suggestion is by no means a new one.

W. B. WRIGHT.

28 Jermyn Street, S.W., March 27.

Formula for finding the Date of Easter.

It may be of interest to some of your readers to know of the following empirical formula—attributed to the famous mathematician Gauss—for determining in an easy manner the date on which Easter falls in any year from 1900 to 2100:—

(1) The number of the year is divided by 19; remainder = a .

(2) The number of the year is divided by 4; remainder = b .

(3) The number of the year is divided by 7; remainder = c .

(4) $19 \times a + 24$ is divided by 30; remainder = d .

(5) $2 \times b + 4c + 6 \times d + 5$ is divided by 7; remainder = e .

Easter will be the $22 + d + e$ of March, or, if this number exceed 31, it will be the $d + e - 9$ of April.

The calculation for the present year is as follows:—

$$(1) \frac{1906}{19} = 100 + 6 \dots \dots \dots \dots \quad (a=6)$$

$$(2) \frac{1906}{4} = 476 + 2 \dots \dots \dots \dots \quad (b=2)$$

$$(3) \frac{1906}{7} = 272 + 2 \dots \dots \dots \dots \quad (c=2)$$

$$(4) \frac{(19 \times 6) + 24}{30} = 4 + 18 \dots \dots \dots \quad (d=18)$$

$$(5) \frac{(2 \times 2) + (4 \times 2) + (6 \times 18) + 5}{7} = 17 + 6 \dots \dots \quad (e=6)$$

As $22 + 18 + 6$ is in excess of 31, we take the alternative $18 + 6 - 9 = 15$, on which day of April Easter falls this year.

CHAS. LEIGH.
The Victoria University of Manchester, March 30.

Chinese Names of Colours.

In your issue of January 11 (p. 246) Mr. Alfred H. Crook writes respecting the name given by the Chinese to a certain tint of blue, which he translates quaintly as "snow-green colour." The following explanation may be of interest to him and to others of your readers.

雪青 (*hsüeh tsing* *seh*) the word he translates "snow," also means "ice," and to the natives of southern China is far better known in reference to the latter object than to the former, as the same name is applied to both natural and artificial ice.

青 *Tsing* originally meant "clear," "tranquil," "smooth" (applied to water). The change from "smooth water" to the "colour of smooth water" is an easy one, so that a secondary meaning of the word is "sea-green" or "sea-blue." Quite different words are used to express other green tints, such as grass-green, and other blue tints, such as indigo-blue.

Putting the two words together, one finds the meaning of

色青雪 (*hsüeh tsing* *seh*) to be "ice-blue colour" or "blue ice colour." Anybody who has noticed the tint of ice in great masses such as one gets in north China and in Switzerland, and who has seen the colour referred to by Mr. Crook, will agree with me in saying that the name given by the Chinese, far from being fanciful, is very appropriate.

L.
Hong Kong, February 15.

The Adulteration of Butter.

My attention has been directed to an article in your issue of March 15 on "The Adulteration of Butter" in which your contributor refers to the composition of butter fat as a triglyceride of oleic, palmitic, and butyric acids, or as containing such a substance. Some years ago I traced this opinion to Mr. Bell, a former analyst of Somerset House, who appears to have based his conclusions upon

the insolubility of butter fat in alcohol. Butter fat is, however, soluble in alcohol, and I have no doubt whatever that a process of fractional precipitation from this solution would enable us to ascertain with fair accuracy what the real constituents are. My own experiments certainly pointed to a great number of separate glycerides being present, palmitin and stearin separating out in tolerable purity. The separation of the lower fatty acid compounds is more difficult to attain, probably owing to their existence as esters. It would be interesting to know whether the theory of the presence of triglyceride rests upon a more stable foundation than that of Bell's statement.

J. H. LESTER.

Royal Exchange, Manchester, March 17.

YOUR correspondent scarcely does justice to Dr. Bell's observation.

Whether butter fat is completely soluble in alcohol or not depends upon the volume, strength, and temperature of the solvent. Bell showed that when the simple glyceride tributyrin was mixed with melted ordinary fat to the extent of 10 per cent., it could be entirely removed by treatment with warm alcohol. But when butter fat was similarly extracted, from 2 per cent. to 3 per cent. only of the fat was dissolved out, and the soluble portion was not tributyrin. Therefore the butyric acid of butter fat is not present as the simple glyceride tributyrin, but chiefly or wholly as a mixed glyceride. Further, the portion dissolved from the butter was found to contain "soluble" and "insoluble" acids in proportions agreeing closely with those required for the mixed glyceride oleo-palmitobutyryl.

Some years later (Proc. Chem. Soc., 1889) Blyth and Robertson noted the isolation from butter fat of a crystalline mixed glyceride, to which they ascribed the formula of palmito-stearo-butyryl.

The "presence of triglyceride" in butter fat will hardly be questioned; what your correspondent has in mind is, apparently, the occurrence of mixed (*i.e.* complex) glycerides. Many such have been isolated from various natural fats in the last few years; this is, in fact, the most notable feature in the recent chemistry of fats. That complex glycerides exist in butter Bell's and Blyth's experiments leave no reason to doubt, though more rigorous proof of their precise composition is desirable.

March 20.

C. SIMMONDS.

The Existence of Absolute Motion.

In discussing this question it is surely necessary to place stress on the contrast between the places of absolute direction and absolute position in dynamics. The result of observation is that the laws of motion are competent to explain such phenomena as nutation and retain the simple Newtonian form when certain directions which can be found with reasonable accuracy are assumed to be absolute. The contrary assumption, that these directions were not absolute, but moving with absolute angular velocities, say of the order of one degree per second, would necessitate a re-statement of the laws of motion involving great loss of simplicity. In the same way, we cannot without loss of simplicity suppose that the acceleration of the earth with respect to the centre of the solar system differs greatly from the absolute acceleration, and suggest that the material universe has an absolute acceleration of the order of one hundred miles per second per second.

On the other hand, the laws of motion would not be modified in the slightest if the whole universe possessed a uniform and constant absolute velocity, however great that velocity might be, even, for example, ten times the velocity of light. Compared with such a velocity as this, the velocity of the solar system relative to the centroid of the visible stars is probably insignificant. Evidence as to the existence of such a velocity must be sought elsewhere; dynamics alone will not supply it.

F. J. W. WHIPPLE.

Merchant Taylors' School, E.C.

SAILING CRAFT IN EUROPE AND ASIA.¹

IN these days, when sails are falling more and more into disuse for ocean-going vessels, and the construction of sailing-ships is a dwindling industry, it is refreshing to come across a book like this, breathing throughout an intimate knowledge of sailing-ships and sailors, displaying insight into, and sympathy with, the nature of the men who follow the sea on the coasts of many countries, and showing in every page powers of quick observation and ready understanding of all that makes for the efficiency of sailing craft. The author indicates his recognition of the inevitable triumph of the steam-ship in competition with the sailing-ship for purposes of both peace and war, but he rejoices no less in the belief that throughout all time fishing- and coasting-vessels will remain dependent upon sails, and so will constitute a school of seamanship in which the traditions of the past will be maintained. Mr. Warington Smyth describes the volume modestly as "an attempt to record the peculiarity of the principal types of sailing craft in Europe and Asia which I have observed . . . and to consider the causes which have been at work in the development of boats and the results attained under the conditions with which they have had to contend."

This attempt has been eminently successful, and has resulted in the production of a book which is a perfect treasury of information on the subject treated, is well arranged, brightly written, and beautifully illustrated. The author has received the assistance of many competent authorities in special classes of vessels described. Captain Drechsel has dealt with Danish vessels; Mr. Colin Archer, the well known naval architect of Larvik, has been responsible for details of Norwegian types; Mr. Robert Duthie, of the Scottish Fishery Board, has given valuable information in regard to the Scottish fisheries, and other friends have assisted in regard to extra-European types. The descriptions are arranged in geographical divisions, which is not merely the most natural scheme, but also that which best brings into relief the underlying motive of the book, namely, the illustration of the influence of local conditions upon form, type, and sail-plan. Other writers, notably the late Mr. Dixon Kemp, and those who, since his death, have continued the revision of his work on "Yacht and Boat Sailing," have emphasised the influence of local conditions, and gathered large stores of information illustrating the general principle. In most cases these writers have dealt with the subject from a more technical standpoint than that assumed in the volume under review. It must not be assumed, however, that Mr. Warington Smyth has neglected technicalities or unduly sacrificed them to a popular treatment of his subject. On the contrary, for many classes of sailing-vessels he gives the "lines" (or building drawings) and the sail-plans, and his portraiture of

both hulls and sails in the vignettes scattered freely throughout the text are admirable in their details. The interest of the book is increased by the introduction of numerous reproductions of famous pictures of shipping, and no pains have been spared by the publisher either in regard to these illustrations or to other features for which he is responsible.

Mr. Smyth excludes from his survey pleasure boats, yachts, and square-rigged vessels, and gives adequate reasons for that course. About one-half of the book is devoted to European types, beginning with the Baltic and Scandinavian countries, and passing to Holland, Scotland, the east coast of England and the Thames estuary, the south and west coast of England, and then to France and the Mediterranean. To English readers, probably the most interesting section of the book will be that dealing with Eastern

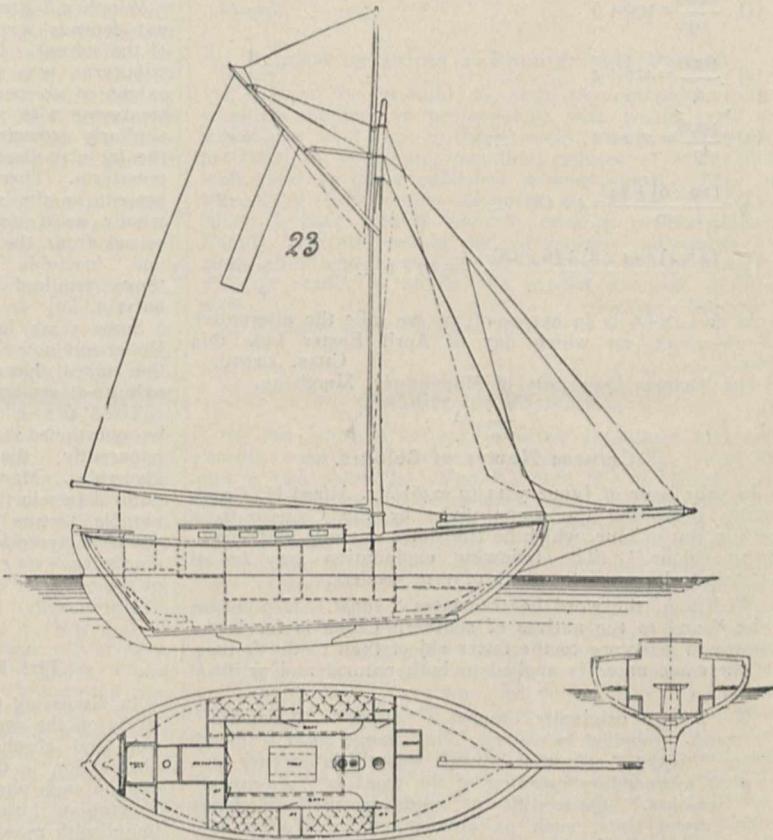


FIG. 1.—Norwegian Pilot-boat—Sail and Cabin Plans. From "Mast and Sail in Europe and Asia."

vessels, including those of the Indian Ocean, the Malay Peninsula, the Gulf of Siam, and China. Here we find special types of great antiquity, differing widely from Western vessels, but well adapted for their special services and surroundings. Mr. Smyth combines philosophical reflection with a yachtsman's enthusiasm and a technical knowledge which goes beyond that of the ordinary amateur, and this fact adds to the charm of his book.

One quotation may be permitted, even within the limited space available in this notice, as indicating this side of his work. He says:—"It is probably true that the degree of civilisation of any race is remarkably reflected in its boat architecture. The variety of its adaptations to the peculiar requirements of its waters is a measure of its appreciation of the value of the cheapest and most certain method of communication known to man; and it is evidence of

¹ "Mast and Sail in Europe and Asia." By H. Warington Smyth. Pp. xix+448. (London: John Murray, 1906.) Price 21s. net.

its ability to use materials at command and fit them to its needs. The highest degree of civilisation in maritime races has always been marked by activity in boat-building and by variety of design and rig. In no case has this been more notable than in the history of China and of Holland, and in the Adriatic in the fifteenth century, in Europe during the last two centuries and in the United States since 1780. The Negro, the American Indian, and the Slav, on the other hand, have never designed a sea-going boat or cut a sail. It has not been for want of water-ways or of opportunity. It has been simply owing to a lower class of intelligence and to want of originality and enterprise."

Mr. Smyth's allusions to the indirect influence upon character and resource of life and work in vessels equipped with sail power are also notable:—"It is above all in the men who handle sails that the self-reliance which is bred by tempest, darkness and the shadow of the Angel of Death reaches its highest point. The seriousness, from this point of view, of the loss of masts and yards to the Navy has been fully recognised, and it has only been reluctantly ac-

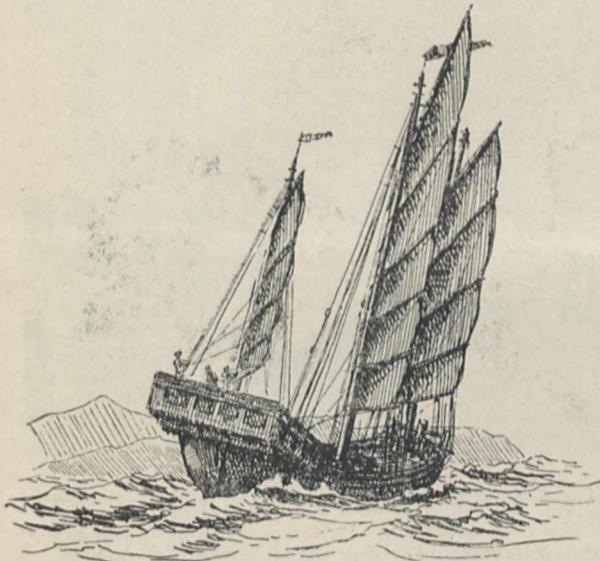


FIG. 2.—Hong Kong Junk. From "Mast and Sail in Europe and Asia."

ceded to on account of the pressing importance of other more essential forms of training. But amongst the coasters and fishermen of the world the mast and sail more than hold their own; and here a student of the sea will find himself in a by-path of the modern world, among the old thoughts, the old traditions, the old methods, and the old virtues of the great seas. And when this civilisation shall have condemned itself and passed the way of others, the lug-sail and the lateen will still be navigating the deep, conned by other races, but the same grim, great-hearted sailor men."

Enough has been said to indicate that, in our judgment, this book should find a hearty welcome from all who love to sail the seas and manage their own craft, and from all who are interested in the maintenance and development of that hardy race of seamen bred on the coasts of the United Kingdom, and leading a life of hardship, difficulty, and danger which must develop qualities of the highest value to the maritime greatness of the British Empire.

W. H. WHITE.

NO. 1901, VOL. 73]

THE SOLAR ECLIPSE OF 1905.

IT is very satisfactory that reports of the recent eclipse expeditions indicate that at some stations the weather conditions were all that could be desired, because we know that at several stations opportunities for securing good results were frustrated by clouds. The Hamburg Observatory party chose a spot which, however, did not come under the second category, and judging by the first portion of the report published,¹ which deals chiefly with the general arrangements and journey to and from the position of observation, it achieved complete success in all lines of work. The report itself is of great interest, and is accompanied, not only by excellent reproductions from photographs of camp scenes, &c., but by capital pictures of the corona. The style of reproduction here employed is to be highly recommended, and other publishers of reports might with advantage copy the good example set.

The party was not a very large one. It consisted of Prof. R. Schorr, the director of the observatory, Dr. Schwassman, the observer, and an observatory attendant, Herr Beyermann, and they were assisted by Prof. Knopf, director of the Jena Observatory, who joined the expedition.

The station selected and used as the observing position was Souk-Ahras, in Algeria, lying on the railway from Tunis, and to the south-west of Bône. The accompanying illustration shows the station occupied, with the several instruments in position. The work of the expedition was chiefly devoted to the following points:—structure of the inner corona; photography of the outer corona and extensions; a search after intra-Mercurial planets; the determination of the brightness of the corona and the total daylight during the eclipse; contact, meteorological, and other observations. The only spectroscopic work attempted was the employment of a Thorp diffraction grating to secure the spectrum of the corona.

For the attack on the inner corona a horizontal telescope of 20 metres focal length was employed. With this, very excellent photographs were obtained. Perhaps the most interesting part of the account of these photographs is the recording of three or four oval, ring-formed, cloud-like caps which lay at a distance of 4 to 6 minutes of arc above the large prominence on the east limb, and indicated a close connection with the eruptive nature of the prominence. These rings, it may be remembered, were also photographed by the Greenwich Observatory party under the direction of the Astronomer Royal, which observed at Sfax, in Tunisia, so that an independent photographic record of them is very important, as this is the first time they have been caught on the sensitive film. That such phenomena have been previously seen will be gathered from the following extract² relating to some spectroscopic observations made by Sir Norman Lockyer in 1870:—

"And what was going on, while this was happening? A prominence, obviously with its root some distance from the limb, had gradually travelled beyond the limb; in appearance it became very much more elevated, and seen, as it were, in perspective over the limb; but what I saw first was very rapidly changed, in a way that would be explained by supposing that cyclones were being shot up into the solar air like bombs! the changes in the F line were so rapid and curious. I was not observing with an open slit, so I at once coined the term 'motion forms,' because the forms observed did not in any way represent the shape of the prominence. But the

¹ *Mittheilungen der Hamburger Sternwarte*, No. 10.

² "Solar Physics," by Sir J. Norman Lockyer, p. 402.

extreme velocity can be imagined from the great departure of those bright lines from the stable dark line F, seen below them, and not only that, but we can think out the explicit character of this prominence action. *They were really in this case, as already stated, smoke rings thrown up by enormous circum-solar action.*"

We thus see that after the lapse of thirty-five years these "lozenge" forms, as they were then called spectroscopically, have been caught in the mesh of the photographic plate.

For the search after intra-Mercurial planets two objectives of 10 cm. aperture and 4 metres focal length were used equatorially, and plates were exposed for 120 and 63 seconds. So far as the negatives have been examined, no unknown object has been detected, but it is interesting to remark that on both plates Mercury appears of the fifth or sixth magnitude eleven hours after inferior conjunction.

Successful measures were made of the brightness of the corona with a Weber photometer by Prof. Knopf, but the reductions are not yet quite complete.

one he has chosen, for in the course of some 300 octavo pages he traces the story of the district in which Pickering is situated from pre-Glacial times up to the date of his publication, including the geology, the archaeology early and later, local legends and folklore; and very good miscellaneous reading he makes of it. The earlier sections, however, can scarcely be said to conform with his title-page, for it is admitted that for many thousands of years after the period of his second chapter no human being yet existed in Britain in the latitude of Pickering, and the town itself would, of course, be even later.

There is, however, no harm in this, and it must be confessed that the admirable material existing in the neighbourhood, and the masterly way in which much of it has been treated by competent hands, offer great temptations to include nature's story as well as man's. The Kirkdale cave is one of the best known of these natural features of the locality, and was exhaustively described by Dr. Buckland in 1822 before the Royal Society, in a paper which is a model of scientific analysis. The physical conformation of the country.



FIG. 1.—The Hamburg Observatory's Eclipse Camp in Souk-Ahras. The 20-metre coronagraph is on the right, and the twin equatorial planet-finder on the left.

Shadow bands were clearly seen, and the dimensions of those measured were about 50 cm. long and 4 cm. to 5 cm. broad.

W. J. S. LOCKYER.

THE STORY OF AN ENGLISH TOWN.¹

THE modern changes in literary methods and the demands of the reading public have altered the character of many classes of books, but none has been so much affected as that dealing with topography. The subsidised family history, the elaborate folding pedigrees, plates of armorial bearings or of equally uninteresting tombs of former magnates of the locality, have disappeared from such works, unless their intrinsic interest coincides with that of the subject of the book. Genealogists and students of family history are now provided with publications of their own, surely a change of a practical kind, and one which allows the substantive matter of a topographical work to take its real place. Even when the older fashion is cast aside for the new, however, there are many alternatives in the treatment of local history. Mr. Gordon Home may be said to be thorough in the

hills around rising to a height of upwards of 1400 feet, naturally provides an admirable field for the observation of the action of ice, and here Mr. Home has taken full advantage of the survey made by Prof. Kendall, while the existence and behaviour of the glaciers in the valleys converging on Lake Pickering in the lesser Ice age are made very clear by the diagrams provided. Naturally enough, there is a good deal of elementary geology in these chapters, and Mr. Home at times also gives his imagination a somewhat free rein, but he does not confuse fact and imagination.

Coming to the later times, where geology gives place to archaeological conditions, we are on surer ground; the relics are more plentiful and more directly comparable with similar remains in other localities and even other countries. Hypothesis and even imagination still have their uses, but the more abundant material should keep the student to the safer zone of comparative archaeology. Here again, in the Barrow period, Mr. Home is fortunate in having masters of the craft to appeal to. Dr. Thurnam and Canon Greenwell have both provided ample matter for the story of man during the later Stone and early Bronze ages, and Mr. Home might have drawn upon them more largely with advantage to

¹ "The Evolution of an English Town; being the Story of the Ancient Town of Pickering in Yorkshire." By Gordon Home. Pp. xix+298. (London: J. M. Dent and Co., 1905.) Price 10s. 6d. net.

his book. A few figures of some of the urns and other relics found by Canon Greenwell in the barrows of the North Riding would have formed more instructive illustrations than the somewhat scrappy and heterogeneous plate of "prehistoric weapons" that faces p. 34. A plate of urns in the Pickering Museum is, indeed, given further on, but it lacks typological qualities. Much has been done during the last few years towards the classification of barrow remains, more especially in the case of the pottery, and there should be no difficulty in presenting a series from so rich a district as Pickering on a plan more in accordance with the results of recent research. In spite of such occasional lapses Mr. Home carries the reader through the story with considerable skill and vivacity. A later chapter will probably be found the most interesting to the general reader, that dealing with local legends, witchcraft, and folklore. Here



FIG. 1.—Relic of witchcraft found in the neighbourhood of Pickering. The figure was made of pitch, beeswax, bullock's blood, hog's lard, and fat from a bullock's heart. It was used for casting spells on people, the pin being stuck in the figure where the "ill-cast" was required to fall. From "The Evolution of an English Town."

story of the regulations of the Duchy of Lancaster during Plantagenet and later times is full of quaint customs and interesting matter. The book as a whole has a cheerful air, and may well lead some who are unacquainted with the beauties and interest of Cleveland to pay Pickering a visit.

A few points may be worth the author's consideration if his book should reach a second impression. He seems to be unaware (p. 30) that the Bateman collection of sepulchral urns is now in the museum at Sheffield, and a detailed catalogue was published by the curator in 1899; on p. 45 he states that bronze spearheads have been found in round barrows near Pickering, which seems unlikely; and on p. 48 he figures a quern of a known Roman type in the Bronze age section. On p. 57 an unfortunate slip makes *data* singular instead of plural.

THE GROWTH OF BEET-SUGAR IN ENGLAND.

LORD DENBIGH'S motion in the House of Lords on Monday night, asking for a rebate on the present excise duty on any sugar made in this country from beets during a certain limited period, raises two interesting questions. On one of them—the

desirability of the State incurring expenditure in order to establish a new industry in the country—we have little to say in these columns; we may be content to point out that it is possible for a Government department to teach the community businesses previously unappreciated. This very beet-sugar manufacture has been introduced into the United States by the action of their Department of Agriculture, with the result that the production has grown to 210,000 tons of sugar in 1904-5 as compared with 20,000 tons ten years earlier.

The other point in dispute is the possibility of growing satisfactory sugar-beet in this country, with its greater rainfall and lower sunshine than the typical Continental centres of sugar production. However, the experiments, organised for so many years by Mr. Sigmund Stein, of Liverpool, and latterly by Lord Denbigh himself, have amply demonstrated that over the east and south-east of England larger crops of sugar-beet can be grown than in Germany without any loss of quality, either as regards the proportion of sugar in the root or its quotient of purity. American experience also shows how adaptable the sugar-beet is to wide diversities of soil and climate.

The English farmer requires but little education in the management of the crop, since the cultivation it requires differs but little from that of the mangel, though the cost per acre is slightly greater. We may take it as settled by numerous experiments extending over many seasons now that the farmer would be prepared to grow sugar-beet in quantity, provided a price were offered approaching that which is paid by the foreign factories, that is, from 16s. to 20s. per ton of roots. How far the manufacture would be profitable at those rates can only be settled by trial on a commercial scale; a factory must be erected in a suitable district and given a fair working test for two or three years.

While the data available show prospects of a reasonable return on the capital that would be required, one or two difficulties suggest themselves which cannot be resolved except by actual working. The first lies in the provision of labour; the process of manufacture must be practically completed in three months after harvest, and it is doubtful whether labourers could be obtained in this country to work three or four months in the factory and the rest of the time on the land. The other doubtful point is whether the necessary scientific control, for sugar-making from beet is a very specialised piece of chemistry, can be obtained cheaply enough here. Lord Denbigh practically asks the State for a little assistance to get these points settled; with a rebate of the excise duty, equivalent to a bonus of 2s. 6d. per cwt. on sugar manufactured from beet grown in England, there is a sufficient margin of profit in sight to draw the capital required for the first factory, and a very few years would suffice to demonstrate whether the business would be possible without artificial assistance, or whether the experiment must be dropped.

Without doubt, the establishment of a beet-sugar industry would give the farmer an additional outlet in many parts of the country; it would, however, not work the semi-revolution in agriculture which has resulted from it in many other places. The English farmer already practises intensive agriculture, and the mangel crop, so integral an element in a rotation in the south of England, gives rise to the heavy manuring, the thorough cultivation, and the wealth of food for stock which have been the great benefits conferred by the sugar-beet on the agriculture of Germany and the north of France.

PROF. LIONEL SMITH BEALE, F.R.S.

PROF. LIONEL SMITH BEALE, F.R.S., whose death occurred on March 28 at the age of seventy-eight years, was the son of Mr. Lionel John Beale, and was educated at King's College School and King's College, London. A year after taking his degree in medicine he established a private laboratory in Carey Street, Lincoln's Inn, for pathological, microscopical, and chemical research and teaching; and in 1853, at the early age of twenty-five, was appointed professor of physiology and general and morbid anatomy at King's College. He afterwards held the chair of pathology, and finally that of the principles and practice of medicine at King's College, resigning the latter in 1896. For forty years Prof. Beale was physician to King's College Hospital, and among other honours and appointments received by him during his active career may be mentioned the Baly medal in 1871 for researches in physiology; Croonian lecturer to the Royal Society, 1865; Lumleian lecturer, Royal College of Physicians, London, 1875; president of the Royal Microscopical Society, 1879; and Government medical referee for England, 1891-1904.

As a teacher, Prof. Beale was remarkable for his lucidity; and his lectures were admirably delivered, riveting the attention of his hearers. He had the esteem of all his pupils; and those who had the privilege of a closer intimacy with him feel that they have indeed sustained a great loss by his death.

His principal work, that which gained him the Fellowship of the Royal Society, was on the minute structure of the tissues; "Beale's carmine stain" and his injection mixtures are well known to all microscopists.

Prof. Beale was the author of many works, among the best known being the "Archives of Medicine," containing researches carried out in the laboratory at Carey Street; "How to Work with the Microscope"; "The Microscope in Medicine"; "Protoplasm, Physical Life and Law"; "The Liver"; and "Slight Ailments and their Treatment," besides many papers in the Philosophical Transactions and other publications of learned societies.

R. T. H.

NOTES.

THE fourteenth "James Forrest" lecture of the Institution of Civil Engineers will be delivered by Mr. K. A. Hadfield on Wednesday, May 2, the subject being "Unsolved Problems in Metallurgy."

THE Government of India has decided, with the approval of the Secretary of State, to establish an institute in India as a centre for practical instruction of medical officers and subordinates in the use and management of Röntgen ray apparatus, and as a dépôt for the storage and repair of such apparatus. The institute will be located at Dehra Dun, and will be under the superintendence of an officer of the Indian Medical Service.

PROF. R. MELDOLA, F.R.S., has been made an Officier de l'Instruction publique of France for his services in connection with the foundation of the Alliance Franco-Britannique, of which association he is the honorary secretary.

A REUTER message states that, after perceptible shocks of earthquake, a crevice, out of which lava flowed, opened on the side of Mount Vesuvius, on March 28, some hundred yards from the upper station of the Funicular Railway. The eruption from the principal crater also continues.

At the Meteorological Office Mr. R. G. K. Lempfert has been appointed superintendent of the statistical branch, Mr. Ernest Gold has been selected for appointment as superintendent of the instruments branch, and Mr. J. A. Curtis succeeds Mr. J. S. Harding as cashier and chief clerk.

THE Easter excursion of the Geologists' Association will this year be to Lyme Regis. The party will leave London on Thursday, April 12, and return to town on Tuesday, April 17. A detailed itinerary and time-table has been published by the association. The excursion will be directed by Dr. H. B. Woodward, F.R.S., and Mr. G. W. Young, the excursion secretary.

THE death is announced of Mr. Carl Heinrich von Siemens. Born in 1829 at Menzendorf, in Mecklenburg, he was the sixth son of a family of fourteen. For the greater part of his life he cooperated with his brothers Werner, William, and Friedrich in the development of the various undertakings with which the name of Siemens is associated. A detailed notice of his career is published in the *Engineer* of March 30.

ACCORDING to a Laffan telegram from New York, dated March 31, the De Forest Wireless Telegraphy Company has been sending experimental messages from its station at Coney Island to Ireland every night for some time, and on March 28 a thousand words were transmitted, of which 572 were received and recorded. The longest distance that had previously been covered by this company's service was from Coney Island to Colon, 2100 miles; the new record is 3200 miles. The sending stations in Ireland are not yet completed, so that a tetrahedral kite is used temporarily for receiving work.

THE following are among the lecture arrangements at the Royal Institution after Easter:—Prof. W. Stirling, three lectures on glands and their products; Dr. P. Chalmers Mitchell, two lectures on the digestive tract in birds and mammals; the Rev. J. P. Mahaffy, two lectures on (1) the expansion of old Greek literature by recent discoveries, (2) the influence of ptolemaic Egypt on Graeco-Roman civilisation; Prof. W. J. Sollas, F.R.S., three lectures on man and the Glacial period; and Sir J. Dewar, F.R.S., two lectures on the old and the new chemistry. The Friday evening meetings will be resumed on April 27, when Prof. J. W. Gregory, F.R.S., will deliver a discourse on ore deposits and their distribution in depth. Succeeding discourses will probably be given by the Hon. C. A. Parsons, F.R.S., Prof. J. H. Poynting, F.R.S., Prof. A. Schuster, F.R.S., Mr. L. Hill, F.R.S., Prof. H. Moissan, F.R.S., Sir James Dewar, F.R.S., and others.

IN the House of Commons on Monday, Sir W. Foster asked why dead specimens of cancer, preserved in a non-deleterious fluid, have been declared to be forbidden admittance to the post, and why certain specimens, addressed to the Imperial Cancer Research Fund, were ordered to be destroyed immediately on their arrival in this country from abroad. In the course of his reply, Mr. Buxton said:—"The cancer specimens addressed to the Cancer Research Fund are, I am informed on the highest authority, harmless; and, as I am assured that the use of the post is of great importance for the successful prosecution of the researches of the fund, I hope to be able to make a special exception in their favour. I think it desirable, however, that the matter should be discussed with the delegates of the countries principally concerned at the approaching Postal Congress, and I have instructed

the British delegates accordingly. In the meantime, packets addressed to the Cancer Research Fund will be delivered."

THE following awards of medals and other honours for this year have just been decided by the council of the Royal Geographical Society:—A Royal (Founder's) medal to M. Grandidier, for the results of his many years' work on the island of Madagascar; a Royal (Patron's) medal to Dr. Robert Bell, F.R.S., director of the Geological Survey of Canada; the Victoria research medal to Prof. W. M. Ramsay, who has been working at ancient geography for many years, and is an acknowledged authority in that branch of study; the Murchison award to Major H. R. Davis, for his explorations in the Shan States, Kachin Hills, Yun-nan, Siam, and Sechuan; the Gill memorial to Major A. St. Hill Gibbons, for the exploring and survey work which he has done in Barotseland on his two expeditions in 1895–6 and in 1898–1900; the Cuthbert Peek fund to Major H. H. Austin, C.M.G., for his exploration in the Lake Rudolf region, the Sobat region, and his expedition from Omdurman to Mombasa *via* Lake Rudolf in 1900 and 1901; and the Back bequest to Major R. G. T. Bright, C.M.G., for his exploring work in the Sudan, Uganda, and East Africa.

IN vol. vii., article v., of the Bulletin of the Illinois State Laboratory, Mr. F. Smith continues his notes on North American oligochaete worms, dealing in this instance with a species of *Lumbriculus*.

THE report of the Australian Museum, Sydney, for the year ending June, 1905, is before us. The most important addition during the year is a collection of ethnological specimens from North Queensland made by Dr. W. A. Roth, protector of aborigines for that district.

IN contrasting different statements as to the purpose and function of museums, the March issue of *Museum News* (Brooklyn, N.Y.) takes occasion to rebuke the "Century Dictionary" for employing the word "curiosities" in this connection, the accumulation of "curiosities" being exactly what every curator who knows his business does his best to avoid.

THE thirty-fourth number of the publications (they have no general title) of the Bureau of Government Laboratories at Manila is devoted to an account of birds from Mindoro and the adjacent islets, and to notes on three birds of rare occurrence in Luzon, one of these latter being the bittern. The first paper, which is well illustrated, contains descriptions of several new species, among them being a needle-tailed swift.

A FULLER account of the Black Hills beetle (*Dendroctonus ponderosae*), a scolytid infesting pine-trees in the Black Hills of South Dakota and elsewhere, described by the author some time ago, is given by Dr. A. D. Hopkins in Entomological Bulletin No. 56 of the U.S. Department of Agriculture. The serious nature of the damage caused by this beetle is indicated by the statement that between 700 and 1000 million cubic feet of timber have been destroyed by it in the Black Hills Forest Reserve alone.

THE third part of the *Bergen's Museum Aarbog* for 1905, of which we have received a copy, contains a long and fully illustrated paper by Mr. O. J. Lie-Pettersen on the marine rotifers of Norway, the result of investigations commenced in the summer of 1900, and a second by Mr. H. Brock on Norwegian medusas. The two last papers

in this part are devoted to archaeological subjects. We have also received a copy of the *Aarsberetning* of the same institution, containing the director's report of progress for the past year.

PART iii. of the third volume of the *Transactions of the Hull Scientific and Field Naturalists' Club* shows careful attention on the part of that body to local subjects. The first article, for instance, deals with the natural aspects of Hull and its neighbourhood; and others are devoted to the East Riding Mycetozoa, local diatoms, and reclaimed lands of the Humber district. Two local celebrities are accorded biographical notices, with portraits, while the editor, Mr. T. Sheppard, discusses the position of the Hull Museum as regards education.

THE papers in the March *Zoologist* comprise one on the birds of the Færöes, and a second on those of Anglesey; while in a third Mr. R. Warren records a change in the habits of herrings visiting Killala Bay, county Mayo. It appears that since 1899 the fish, which used to keep to the bay, have taken, for about three weeks in the autumn, to entering the estuary and tidal part of the river. So close have they on some occasions come in-shore that scores may be taken with a landing-net.

THE contents of the first part of vol. lxxxi. of the *Zeitschrift für wissenschaftliche Zoologie* comprise one paper by Mr. W. Schimkewitsch, of St. Petersburg, on the developmental history of the arachnid *Thelyphonus caudatus*, and its comparison with that of other members of the same group. In a second paper Mr. R. Meyer discusses the histology of the nervous system of the common star-fish, *Asterias rubens*, while in the third Mr. O. Kohlmeyer describes the elastic tissue in the mucous membrane of the palate of the brown rat, the distribution of which has never previously been worked out.

AN extinct volcano in Arizona and its crater form the subject of a paper by Mr. D. M. Barbinger in the issue of the *Proceedings of the Philadelphia Academy* for December last. One of the most remarkable features connected with this mountain is the presence of an enormous mass of meteoric iron. As the result of his investigations, the author comes to the conclusion that a huge meteor, of which at least the outer coat was metallic, fell to the earth in this locality, and that its size was so great that portions of it were fused and detached. Further, a large hole in the adjacent strata was made by the fall of the meteor.

DR. W. J. HOLLAND has sent us a paper on the osteology of the American dinosaur *Diplodocus*, with special reference to the model of the skeleton presented by Mr. Carnegie to the Natural History Museum, and installed by Dr. Holland himself. In this paper, which forms No. 6 of the second volume of the *Memoirs of the Carnegie Museum*, the author directs attention to the pose in which the skeleton has been mounted, explaining that, in his opinion, the peculiar structure of the occipital region renders the angle which the skull forms with the vertebral column a matter of necessity. Dr. Holland finds himself unable to accept Baron Nopcsa's interpretation of the nature of the problematical bone which has been regarded as a clavicle.

THE black locust tree (*Robinia pseudo acacia*) is such a familiar inhabitant of railway banks, especially in parts of France, that we read with interest Dr. Charles A. White's account, in the *Popular Science Monthly* for

March, of the troubles which have beset attempts to establish it in similar situations in America, especially in Pennsylvania. The wood of the tree is excellently suited for making fence posts and railroad ties, but, unfortunately, as soon as the stems attain a sufficient size to be of use they are liable to be destroyed by the burrowing larvae of a longicorn beetle (*Cyllene robiniae*); and so persistent is this beetle in its attacks, that Dr. White considers the further planting of these trees to be sheer waste of labour and money.

THE second number of the *Bio-Chemical Journal* contains four papers of considerable interest, and if the present standard be maintained we predict a long and useful "life" for this new publication. Mr. Leonard Hill discusses filtration as a possible mechanism in the living organism, and concludes that it does not occur under natural conditions; Mr. G. S. Haynes, writing on the pharmacological action of digitalis, strophanthus, and squill on the heart, considers that it is essential that these drugs should be standardised, as the amounts of active constituents vary much. He finds that strophanthus is 8 to 10 times as toxic as digitalis, and that squill is an excellent cardiac stimulant. Dr. Roaf and Mr. Whitley contribute a paper on the action of acids, alkalies, and salts on the tadpole; and Dr. MacLean details observations on the Fehling test for dextrose in urine, proving that creatinin is the cause of the masking of the sugar reaction which sometimes occurs in urine-testing.

A BRIEF description appears in the Journal of the Royal Microscopical Society (February) of a newly discovered synangium that, as the writer, Mr. D. M. S. Watson, states, would two years ago certainly have been regarded as the fructification of a marattiaceous fern. The synangium consists of from four to seven sporangia grouped round a central receptacle that is hollowed out into a cup at the top, thus bearing considerable resemblance to the sporangia of the recent fern *Kaulfussia* and of the fossil species *Ptychocarpus unitus*. Having regard to Mr. Kidston's discovery that the synangium of *Crossotheca*, formerly considered to be that of a marattiaceous fern, was the male fructification of *Lyginodendron*, Mr. Watson leaves it open whether the new species, *Cyathotrichus altus*, should be placed in the ferns or cycadofilices.

IN connection with the work of the instructors in horticulture that have been appointed by certain county councils in Ireland, it has been found that there is need of a scientific journal that will help to supply the knowledge required by small farmers and occupiers of holdings. To meet this want a new monthly publication, *Irish Gardening*, has been started, the first number having been issued this month. After a short note of encouragement from Sir Horace Plunkett, Mr. F. W. Moore provides an appropriate article on the present condition of horticulture in Ireland. The use and value of horticultural demonstration plots is discussed by Mr. J. G. Toner, and a trite comparison of English and Irish potatoes is contributed by Prof. J. Wilson in which, while upholding the quality of the Irish potato, he suggests that there is scope for new Irish varieties. Judging from these articles and the numerous notes on various topics, the new journal promises to fulfil its purpose of directing attention to the scientific principles that underlie good garden practice.

THE discussion on "The Origin of Gymnosperms" at the Linnean Society, arranged for the meeting on March 15, drew a very large audience. Prof. F. W. Oliver, in

opening the discussion, referred to the generally accepted view that the line of descent of the gymnosperms had proceeded through the ferns and cycads, this view being supported by the discovery of multiciliate spermatozoids in *Ginkgo* and in cycads, and by the recognition of the fossil group of cycadofilices. The discovery of seeds in connection with several of the Palaeozoic "ferns" had led to their transference to a new and rapidly increasing group of pteridosperms. If the Palaeozoic were an "age of pteridosperms" rather than an "age of ferns," was the filicinean origin of the gymnosperms weakened, and should a lycopodiaceous origin be sought? Personally, he favoured a derivation of the pteridosperms and eventually the cycads and Cordaitae from the ferns. Mr. E. A. N. Arber, dealing with the earlier geological records of the true ferns, also expressed his adherence to the fern-cycad line of descent. He instanced the Botryopterideæ as true ferns existing in the Carboniferous and Permian ages, and pointed out that the connection of gymnosperms and ferns must have been far back in the Palaeozoic epoch. Prof. A. C. Seward, while accepting the filicinean origin for the cycads, dissented from the view that the conifers followed the same line of descent. His recent investigations of the Araucarieæ pointed to their being a very ancient group of gymnosperms, and for them, if not for conifers generally, he considered a lycopodiaceous derivation as the more probable. Owing to the late hour, Dr. D. H. Scott was unable to give his address, as announced, so the proceedings were postponed to the meeting fixed for May 3, when an opportunity will be afforded for other members to take part in the discussion.

THE work of the expedition dispatched by the Smithsonian Institution of Washington to the Canadian Rockies and Selkirks, under the direction of Prof. W. H. Sherzer, of the Michigan State Normal School, is described in the report of the late Dr. S. P. Langley for the year ending June 30, 1905. The expedition had a successful season's work on the glaciers along the line of the Canadian Pacific Railway. A selection was made of those five glaciers which are most accessible to the student of glacial geology, and these were found to exhibit the characteristics of glaciers throughout the world. Four or five days of comfortable railway travel places an investigator in the midst of snow-fields rivalling those of Switzerland, and the ice bodies descending from these fields may be studied from modern hotels as a base, and a horse may be ridden to the feet of the glaciers studied by the expedition. So far as is known, there is in this district the most magnificent development of glaciers of the Alpine type on the American continent, and the purpose of the survey was to gather as much information as possible concerning them. Many photographs illustrating the details of glacial structure were obtained, and a full report of the expedition may be expected later.

WE have received a copy of the results of the meteorological observations made at stations under the control of the Deutsche Seewarte for the year 1904. These observations include those made at ten stations of the second order, at which readings are taken three times daily; at four of these stations, viz. Hamburg, Wustrow, Memel, and Borkum, hourly values and means obtained from self-recording instruments are given in addition. For all days on which stormy weather was experienced on the German coasts, observations for several times a day are published from those of the fifty-six storm signal stations affected. This valuable publication forms one of the series of "Meteorological Year-books" issued by the various organisations

of the German Empire; these are all identical in form, the plan of which is practically that adopted by the International Meteorological Congress at Rome in 1879, and leaves nothing to be desired. With the exception of an occasional improvement, such as the reduction of the old anemometrical factor, which assumed that the velocity of the wind was three times as great as the velocity of the cups of the instrument, and the addition of a table showing for each station the difference between local time and mid-European time adopted in Germany in April, 1893, there has been practically no change in the contents of publication for many years. This continuity of form is a great advantage, and considerably enhances the value of the work.

WE have received from the director of the Vatican Observatory, Sig. P. Angelo Rodriguez, O.S.A., vol. vii. of the *Pubblicazioni della Specola Vaticana* (Tipografia Vaticana, Rome, 1905). In these pages we first have the individual daily meteorological observations made during the years 1902 to 1904, both years inclusive. These are graphically plotted in three tables which are given at the end of the volume. Sig. Mg. Alfredo Tonetti contributes a valuable study of the cloud observations made during the years 1891-6, and this is followed by two appendices, which include observations of meteors for the years 1891 to 1896, and the mean monthly values of cloudiness for the same period. Among other sections of interest may be mentioned a brief discussion of the exceptional high temperatures recorded in July and August of the year 1904, comparison data being added commencing in 1890. Sunspot observations are also dealt with, and, in addition to the individual daily observations, a summary for each year, commencing with 1896, is added. Special reference is made to the large spot of February, 1905, and a reproduction (original size) of the solar disc for February 7 is added, the original photographic image measuring nearly eleven inches in diameter.

IN the Transactions of the Institution of Engineers and Shipbuilders in Scotland (vol. xlix., part v.), Mr. W. A. Ker publishes a suggestive paper on some common errors in the use of electric motors for machine driving. In it he gives a list of common machines, with the types of motors which he considers most suitable for them.

ATTENTION is directed in the *Engineering and Mining Journal* (vol. lxxxii., No. 10) to the very low cost of ore dressing which has been attained at the mill of the Osceola Copper Mine, Lake Superior. The average cost per ton of rock stamped in 1905 was only 8½d., as against 9d. in 1904. These extraordinary figures were obtained in the treatment of a million tons of rock per annum, all the ore passed through the mill having been crushed to go through a ¼-inch to 3/16-inch round hole.

THE locomotive industry is dealt with in an exhaustive paper by Mr. L. Le Chatelier in the *Bulletin de la Société d'Encouragement* (vol. cviii., No. 2). Beginning with Trevithick's locomotive of 1803, he illustrates the leading types, and expresses the opinion that the works of the Hanover Engineering Company represent the most perfect example of the international locomotive industry. The Crewe works, with their 7500 workmen and their annual output of seventy-five locomotives, are referred to by the author in terms of warm admiration.

"ECONOMIC Studies in Italy" form the subject of a letter by Prof. Achille Loria in the *Economic Journal* for March. A noteworthy feature of Italian economics is the absence of any scientific treatment of socialistic problems.

IN the Bulletin of the Belgian Royal Academy (1905, xi.), the death is announced of the oldest member, M. Gustave Davalque, who was elected associate in 1854 and member in 1859, and drew up reports on mineralogy for the society subsequent to 1872.

PROF. LUIGI BERZOLARI contributes to the *Rendiconti* of the Lombardy Institution an interesting account, extending to more than sixty pages, of the work of the late Prof. Luigi Cremona. A list of previous biographical notices is given in a footnote.

PROF. G. CESÀRO, of Liége, describes in the Bulletin of the Belgian Academy, x., a new method of proving geometrically the principal formulæ of spherical trigonometry, notably Lhuillier's and Euler's formulæ, Napier's and Delambre's analogies, and the expressions for the radii of the circles of a triangle.

MR. H. M. TAYLOR, F.R.S., has published in the *Messenger of Mathematics*, No. 414, a collection of geometrical dissections, in which it is shown how to transform figures from one shape into another by division into a definite number of parts and re-arrangement of the parts. While these constructions afford a highly interesting study, it may be desirable to point out that if it be required, for example, to convert a rectangle into a square of equal area by this method, the construction presupposes a knowledge of the side of the required square.

IN the Bulletin of the American Mathematical Society for January Prof. Jacques Hadamard gives a review in French of the late Prof. Willard Gibbs's "Elements of Statistical Mechanics," which appeared in 1902. Based as the review is on a detailed study of Gibbs's work and of criticisms thereon, the notice forms in some respects an innovation in reviewing which might with advantage be followed on other occasions in connection with mathematical works. It is certain that the book in question contained many features that could only be properly judged after long and minute study.

IN a paper reprinted from the *Abhandlungen* of the Royal Academy of Saxony, xxix., 4, Dr. Otto Fischer discusses the dynamics of the motion of a system of bodies jointed together and moving in space. An illustration of such jointed systems is afforded by the limbs of animals. In general, a system of n jointed bodies has $3n+3$ degrees of freedom, but there are many cases in which the number is less, and the author shows how the equations can be simplified by replacing the system by a dynamically equivalent set of particles or "reduced system."

UNDER the title "Abhandlung zur Didaktik und Philosophie der Naturwissenschaft," Messrs. Julius Springer, of Berlin, are issuing a series of pamphlets, in the form of monograph supplements to the *Zeitschrift für den physikalischen und chemischen Unterricht*. The object of these pamphlets is to give expositions of various points connected with the teaching of the sciences in question. No. 5 of the series is by Prof. Hans Kesten, of Hamburg, and contains an exposition of the elementary properties of lenses and optical combinations treated from an experimental point of view. In the introduction the author points out that two of the various branches of physics, mechanics and optics, are made to assume a more mathematical aspect than the rest, the former by introducing the concept of particles, which reduces the study to that of certain systems of *points*, the latter by the concept of rays, leading to the study of certain systems of *lines*. The

present pamphlet treats exclusively of the magnifications produced by lenses, the paths of the rays, and the principles of the microscope and telescope.

THE danger which may accompany the teaching of elementary chemistry to children has been sadly illustrated by the death of a girl of fifteen years of age—a pupil at the Plymouth Secondary School—caused by swallowing a strong solution of caustic soda while working in a practical chemistry class. The coroner's inquest showed that the child—one of a class of eight—misinterpreted the directions given by the instructor, and sucked into a pipette a concentrated solution of the alkali without previously diluting it, as she had been told to do; in doing this she managed to swallow some of the solution. In view of the fact that three other pupils out of the eight in the class gave evidence showing that they also had not followed the directions given, it is clear that, in order to guard against such accidents, the experiments should be devised in such a way that, in the event of a misunderstanding, no evil results may accrue. In the present case, for instance, in which the neutralisation of sulphuric acid by caustic soda was being studied, the concentrated solutions might have been diluted by the demonstrator in front of the class, and the diluted solutions thus prepared then have been used for the pupils' measurements. Other simple expedients could readily be suggested in which the use of an ordinary pipette is avoided. In the practical study of chemistry there are many possibilities of accident, and this should be borne in mind by the examining and inspecting authorities which prescribe the work to be done in school laboratories, and by the teachers who devise experiments for their pupils. It should be unnecessary to add that the instructor, particularly when he has to deal with children, should not only have seen chemical experiments performed, but have acquired by a prolonged course of laboratory work a real knowledge of manipulation and of the dangers likely to be incurred in any case.

MESSRS. JOHN J. GRIFFIN AND SONS, LTD., have issued a third edition of their well illustrated list of apparatus for electrochemistry, arranged for students working through Dr. Lüpke's "Grundzüge der Electrochemie."

A POPULAR article, with several striking illustrations, upon the eye-spots exhibited by various creatures as ornaments or for protective purposes appears in the April number of *Pearson's Magazine*.

THE current issue of the *Home Counties Magazine* contains, among other interesting matter, a reprint of a lecture by Mr. M. J. C. Meiklejohn on the place-names of Northwood and district, and the first of a series of articles in which the editor, Mr. W. Paley Baldwin, has collected all available references to Paul's Cross, and arranged them in chronological order.

THE current number of *Past and Present*, the successor to the *Natural History Journal*, published in connection with the Friends' Schools, is before us. The magazine shows that great encouragement is given in these schools to observational science, and that the boys are in the habit of making and recording outdoor observations in biological and meteorological science. The illustrations of the school buildings are proof enough that the claims of science are not forgotten in the school curriculum.

SEVERAL parts of volumes of *Transactions of the Royal Society of Edinburgh*, containing papers read before the society during the sessions 1902-3, 1903-4, and 1904-5, have just been received; and also vol. xlvi. of the *Transactions*,

edited by Dr. A. Buchan, F.R.S., and Mr. R. T. Omond, devoted to the Ben Nevis observations during the years 1893-7. As abstracts of the papers read before the society appear periodically among our reports of meetings, it is unnecessary to refer again to the many important contributions now printed in full in the *Transactions* recently issued.

THE fifth part of vol. ii. of the *Proceedings of the University of Durham Philosophical Society* has been received. The number contains five papers read before the society between February 9 and April 27, 1905, together with the proceedings for the academic year 1904-5. Prof. H. Stroud contributes a paper on spark-gap experiments for detecting radio-activity, Dr. J. A. Smythe a note on a contact rock from the Island of Mull, Mr. A. Brennan notes on abnormal flowers of *Lilium Martagon* (Linn.), Dr. D. Woolacott a paper on the pre-Glacial "wash" of the Northumberland and Durham coalfield, and Mr. G. Thomson one on the effect of light on selenium.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN APRIL:—

April 5. 5h. 48m. to 6h. 42m. Moon occults α Leonis (Regulus, mag. 1.3).
 6. 7h. 3m. to 7h. 57m. Moon occults χ Leonis (mag. 4.7).
 , 15h. 50m. to 16h. 19m. Moon occults σ Leonis (mag. 4.1).
 11. 11h. 30m. Minimum of Algol (β Persei).
 14. 8h. 19m.
 15. Venus. Illuminated portion of disc = 0.967. Or Mars = 0.978.
 16. 15h. 48m. to 16h. 29m. Moon occults θ Capricorni (mag. 4.2).
 18. 23h. Saturn in conjunction with Moon. Saturn $0^{\circ} 22' N.$
 24. 8h. 22m. Transit (ingress) of Jupiter's Satellite III. (Ganymede).
 , 15h. Venus in conjunction with Moon. Venus $5^{\circ} 11' N.$
 26. 4h. Jupiter in conjunction with Moon. Jupiter $4^{\circ} 16' N.$
 , 5h. 42m. Near approach of Moon to α Tauri (Aldebaran).
 27. 8h. 51m. to 9h. 48m. Moon occults 119 Tauri (mag. 4.6).
 30. 11h. 33m. to 12h. 28m. Moon occults ζ Canceris (mag. 4.7).

COMET 1906b.—A part of the ephemeris for comet 1906b (Kopff), calculated by Herr M. Ebelt and published in No. 4080 of the *Astronomische Nachrichten*, is given below:—

Ephemeris 12h. M.T. Berlin.

1906	α (true) h. m. s.	δ (true) °	$\log r$	$\log \Delta$	Bright- ness 0.81
April 6	II 22 53	2 24	0.5355	0.3983	
14	II 21 18	2 28	0.5397	0.4128	0.74
22	II 20 38	2 26	0.5440	0.4291	0.67
30	II 20 58	2 20	0.5484	0.4468	0.61

Unit brightness on March 3 = about mag. 11.0. This comet is still in the constellation Leo, near to the star τ , which is on the meridian at about 11 p.m.

The suggestion that this object was a periodic comet of short period is not confirmed by the observations.

Observing at Strassburg on March 17, Dr. Wirtz recorded that the comet had a nucleus of mag. 11.5, the total magnitude being 11.0. The nebulosity was only 0'7 in diameter, and appeared to be extended towards position angle 270° .

COMET 1905c.—The following is an extract from Herr Wedemeyer's ephemeris for comet 1905c (Giacobini) as published in the supplement to No. 4080 of the *Astronomische Nachrichten* :—

Ephemeris 12h. M.T. Berlin.					
1906	α (true) h. m. s.	δ (true)	$\log r$	$\log \Delta$	Bright- ness
April 5	3 36 46	+ 8 12	0.2390	0.3763	0.20
9	3 45 22	+ 9 8	0.2559	0.3943	0.17
13	3 53 33	+ 9 59	0.2718	0.4114	0.15
17	4 1 22	+ 10 46	0.2870	0.4275	0.13
21	4 8 53	+ 11 28	0.3014	0.4428	0.11

An observation at Strassburg on March 17 gave corrections of -11° and $-3^{\circ}9$ to this ephemeris. The comet was pale, with no certain nucleus, and the ill-defined nebulosity was about $2'$ in diameter; total magnitude about 11.5 .

This faint object is now apparently traversing the constellation Taurus towards the Pleiades, and will be some 3° south of that asterism on April 23. It sets, a little to the N. of W., at about 9 p.m.

A SYSTEMATIC STUDY OF FAINT STARS.—Apropos of Prof. Kapteyn's plan for studying faint stars, Prof. Pickering gives a detailed account of how similar work is being performed at Harvard College Observatory in *Circular No. 108*.

It is impossible to describe the whole work here, but both photometric and photographic methods are being employed, and by using the two 24-inch reflectors Prof. Pickering hopes to extend the survey to stars fainter than *Phoebe*.

In studying the spectra, the 8-inch Draper and Bache telescopes have been employed, and stars down to the eleventh magnitude have been observed successfully. Using the 24-inch reflectors, Prof. Pickering hopes to photograph the spectra of much fainter stars.

By following the stars precisely, so that the resulting spectrum is merely a line, thirteenth magnitude stars have been dealt with, and, on a photograph obtained with the 8-inch Draper telescope, the spectrum of a star of mag. 13.3 is sufficiently clear to be classified; the same plate shows the spectra of 110 stars within 1° of the North Pole.

STARS HAVING PECULIAR SPECTRA.—In *Circular No. 111* of the Harvard College Observatory, Prof. Pickering gives a list and details of twenty-four stars which, from a study of the Henry Draper memorial photographs, Mrs. Fleming has found to have "peculiar" spectra.

One or two of the objects call for special remark. The star D.M. $+21^{\circ} 1609$ is identical with N.G.C. 2392, which was found to have a continuous spectrum, with three bright lines, by Wenlock and Peirce on January 7, 1869. D'Arrest, also, found it to be gaseous. Photographs taken at Harvard on November 21, 1900, and November 27, 1905, show no traces of the bright lines characteristic of gaseous nebulæ, but that its spectrum is of the fourth type. This star is in Gemini, its approximate right ascension and declination (for 1900) being 7h. 23.3m. and $+21^{\circ} 7'$ respectively.

In the spectrum of the star D.M. $+36^{\circ} 3907$ the hydrogen line $H\beta$ appears as a fine bright line centrally superposed on a dark line, on photographs taken on July 4 and November 4, 1905.

A spectrogram of the variable star R Cygni, obtained on November 19, 1890, showed the hydrogen lines $H\gamma$ and $H\delta$ bright, but a photograph taken on December 7, 1904, with the same instrument, shows a spectrum of the fourth type containing no trace of bright hydrogen lines.

THE LUNAR ECLIPSE OF FEBRUARY 8.—The total eclipse of the moon which took place on February 8 this year was fully observed at the Goodsell Observatory, Northfield, Minn. (U.S.A.), and an account of the observations is given in No. 3, vol. xiv., of *Popular Astronomy*.

Dr. Wilson especially remarks on the brightness of the eclipsed moon, and on the remarkable contrasts of colour seen on the darkened surface.

Five photographs were secured, and the last one, taken with a small camera attached to the telescope, exposure 5m., shows the details of the lunar surface and its unequal colouring very plainly.

Similar observations were made by M. Quénisset at the Nanterre Observatory, and four of his photographs are reproduced in the March number of the *Bulletin de la Société astronomique de France*. He records the shadow as "very transparent."

PARALLEL RUNNING OF ALTERNATE CURRENT GENERATORS.

THE *Bulletin des Séances de la Société française de Physique* for the second quarter of last year contains an interesting article by M. Boucherot on the general principles which enter into the design and construction of alternating current generators.

After a brief description of the present methods of construction, the author passes on to consider, first, the wave form; secondly, the regulation; thirdly, parallel running; and, finally, methods of compounding.

The most important part of the article is that devoted to the question of parallel running, and, although the mathematical treatment is not very clearly explained, the conclusions arrived at are interesting.

The question is considered under two headings. In each the subject of inquiry is the influence of the fly-wheel, or the fly-wheel effect of the rotating parts, on the oscillations about a state of uniform angular velocity; but under the first heading the oscillations are caused by the variations of turning effort of the prime mover during a single revolution, and under the second heading the oscillations are produced by the action of the engine governor.

In dealing with the first of these there are two quantities which are of prime importance in the calculations viz. the energy stored in the rotating parts, $W = \frac{1}{2} J \Omega^2$, and the elastic couple or restoring force, C_s , which is defined as the couple which tends to restore the rotating parts to phase coincidence with the network to which the armature is connected, when the deviation is one radian. Then it is shown that the natural period of the system is $2\pi\sqrt{J/C_s}$, and the restoring force $C_s = C_s p k$, where C_s is the full load torque, p the number of pairs of poles, and k the ratio of the short-circuit current to the normal current.

Next, the analysis of the turning moment is given for single-cylinder and for multiple-cylinder engines as follows:—

	Order of harmonic	Half load	Full load
Single cylinder	1	0.12	0.14
" "	2	0.9	0.9
" "	3	0.12	0.11
" "	4	0.4	0.11
Multiple cylinder	1	0.1	0.1
" "	2	0.5	0.2
" "	3	0.35	0.15
" "	4	0.4	0.4

the mean constant turning moment being reckoned as unity.

Each harmonic produces its own oscillation in the rotating system, the amplitude of which is proportional to the value of the harmonic multiplied by $\frac{1/2n^2}{W - W_n}$ (not $W/W - W_n$ as stated in the original), where n is the order of the harmonic and $W_n = C_s/2n^2$. If the total fly-wheel effect happens to be such that $W = W_n$, resonance will occur, and this expression will enable the designer to proportion the rotating parts so as to avoid serious trouble.

More interesting is that part of the article devoted to the effect of the engine governor on parallel running and hunting. The subject is confessedly a difficult one, and at present there is no accepted theory. The suggestion put forward by the author is somewhat compressed and difficult to follow; and, even so, only the chief points of the argument can be mentioned here.

The generating set with its governor is treated as being composed of two interdependent oscillating systems, each with its own natural period and its own coefficient of damping. In addition to these four quantities, two others are of great importance, viz. K , the percentage variation of speed between no load and full load, and T_d , the time lag of the governor. The latter quantity is defined as the time which elapses between the governor reaching its extreme position and the turning moment of the engine taking up its corresponding value. This time lag is greater in compound and triple expansion than in simple engines, due to the passage of the steam through the cylinders.

Considering, first, the case of a generating set connected to an external network assumed to be of infinite capacity, it

is shown that the periodicity of the oscillation is given by the equation

$$\tan(\alpha \cdot T_d) = 1/2m(\alpha_r/\alpha - \alpha/\alpha_r),$$

where $2\pi/\alpha$ is the period of the oscillations produced, $2\pi/\alpha_r$ is the natural period of the governor, and m is the

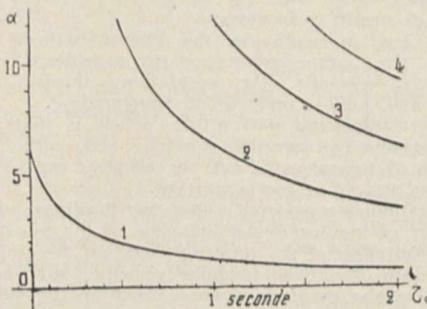


FIG. 1.

ratio of the actual damping of the governor to the smallest value of the same coefficient which makes the governor dead beat.

This equation of α in terms of T_d represents a series of curves, some of which give rise to negative values. The positive values corresponding to $m=1$ and $\alpha_r=6.32$ are

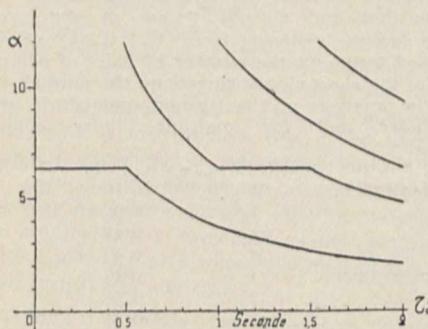


FIG. 2.

shown in Fig. 1. Of these curves, only the lowest one represents oscillations which are not evanescent.

For this case the conclusion is reached that for satisfactory running the percentage variation of speed K must not be too small, and the fly-wheel effect must be designed in proportion to the time lag of the governor.

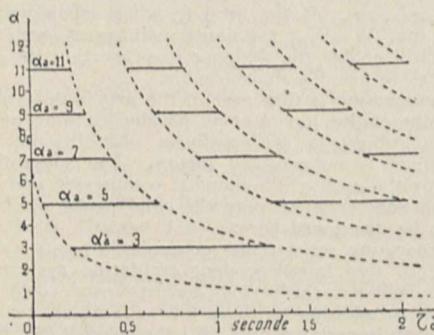


FIG. 3.

Passing to the case where two sets are working in parallel, the equation giving the frequency of the oscillations is similar to the above, provided the damping in the generators is small. In this case, however, the curves which give positive values of α are quite different, being as shown in Fig. 2. The straight line portions correspond

to $\alpha=\alpha_a$, where $2\pi/\alpha_a$ is the natural period of the alternator.

Now the rate of subsidence of any oscillation contains a term $(1-\alpha/\alpha_a)$, and it is consequently clear that it would be unsafe to allow any value of T_d between 0 and 0.5, or between 1 and 1.5, as shown in the figure. If, however, the damping of the governor is much greater than the critical dead-beat value, satisfactory working may be possible.

A point of great interest is brought out in this connection, viz. the influence of the fly-wheel effect. The straight portions of the curves in Fig. 2 depend upon the natural period of the alternator, which in turn depends upon the fly-wheel. The heavier the fly-wheel the less the value of α_a , and consequently the longer the straight portion of the curve as shown in Fig. 3. In other words, the greater the fly-wheel effect the greater will be the range of T_d for which satisfactory working is difficult. From this it would appear that it is quite possible to provide too heavy a fly-wheel.

The article concludes with a brief reference to the various methods of compounding alternators.

GEOLOGICAL NOTES.

IN the *Zeitschrift der Gesellschaft für Erdkunde zu Berlin* (1905, p. 412) Prof. Dr. A. Phillipson, of Bern, outlines his recent journey of 10,000 kilometres through the west of Asia Minor, including Brussa, near the Sea of Marmora, and Makri, on its Mediterranean inlet in the south. The preliminary results indicate the existence of a "Lydian mass" of granite, gneiss, and crystalline schists, which forms on the whole a hummocky country, flattening itself out where the lower course of the Maeander cuts into it. The inhabitants are mostly clustered along the included basins of Neogene deposits. A zone of metamorphic limestones and less altered phyllites lies outside this mass, following the strike of the bow-shaped crystalline core; and the discovery of a new species of Fusulina (p. 417) places part of this outer zone as Permo-Carboniferous. To the south and south-east, the Cainozoic earth-movements have brought up folded limestones of the Cretaceous and Eocene type of Greece and Rhodes. The complete results of the journey will not be worked out for several years.

Dr. G. Steinmann continues, in the *Berichte der naturforschenden Gesellschaft zu Freiburg-im-Breisgau* for September, 1905, his "Geologische Beobachtungen in den Alpen." The question of Klippen-structure and overfolding in the classical Alps of Glarus leads on to a comparison with the eastern Alps. The author gives a valuable exposition of Schardt's views, which were published in 1893, and which led to the conception of the breaking up of an overthrust limestone mass into blocks or "klippen," which lie discordantly among later sediments. Without going so far as Termier (p. 32), Dr. Steinmann sees in this striking theory of overfolding the true explanation of the phenomena of the Bündnerchiefer and the limestone zone, and he appeals to workers in the eastern Alps to consider Schardt's views at least in the light of a scientific possibility. The last part of the present paper includes a bold but reasonable speculation as to the connection between deep-sea radiolarian deposits and diabasic igneous rocks. It is suggested, for the Alpine, Scotch, and other instances, that these basic igneous masses accumulated under the ocean-floors, just as more highly silicated rocks are believed to gather under continents. Consequently, a deep-sea epoch, followed by one of compression and overthrusting, would lead to a squeezing out of "ophiolitic" igneous rocks somewhere along the zone of the radiolarian cherts.

The activity of geological research in the African colonies is evidenced by a recent part of the *Transactions of the Geological Society of South Africa*, published in Johannesburg in September, 1905. Mr. A. L. Hall describes (p. 47) the mode of occurrence of the tin-ore in the picturesque Bushveld area forty miles north-east of Pretoria. The ore was first noticed in the local granite as recently as 1904, and the field was described by H. Merensky in that year. Its exploitation at once followed, and Mr.

Hall has been able to examine the rocks traversed by the new shafts and drives. The field was extended, while his paper was in preparation, by a further discovery on the farm Vlaklaagte. In this case there is evidence of the deposition of the cassiterite in good crystals, of the size of coarse shot, throughout a granitoid rock, which is of later age than the surrounding red granite. Minerals containing fluorine, topaz being among them, are already known in the Bushveld igneous series, and hence there is reason to believe that the tin-ore may have been developed on Enkeldorn and Vlaklaagte in the manner recognised in the "classical stanniferous localities."

Mr. H. Kynaston appropriately describes (*ibid.*, p. 61) rocks allied to greisen, from a point much further north, in the Olifants River Valley. He also adds to our knowledge of the norites and schists associated with the Bushveld granite, perhaps as marginal phenomena. Dr. Molengraaff, whom we regard almost as a veteran in these years of rapid exploration, and as the founder of much of our knowledge of the Transvaal, further supports his view (*ibid.*, p. 63) that the Pretoria series may be correlated with the jasper beds of Griqualand West. He now describes Mr. Leslie's discovery of crocidolite in the ferruginous quartzites of the Pretoria series in the Lydenburg district. These beds overlie the well known dolomite, which thus may be paralleled with the Campbell Rand dolomite of the south. Dr. Molengraaff's account of contact-altered rocks in the Pretoria series should fit in with Mr. Kynaston's observations further north; and the conferences of the Geological Society of South Africa will doubtless show how much of the extensive alteration is due to the granite and felsite series, and how much to the sheets of norite. The present tendency, however, seems to be towards the linking of these two types of intrusive rock in a continuous series.

Mr. Thord-Gray (*ibid.*, p. 66) describes in some detail the occurrences of gold in the Pretoria series round Pilgrim's Rest (Lydenburg gold-field), and concludes in favour of the view that a mineral infiltration, carrying both gold and copper, took place along certain zones of the conformably bedded series. The horizontal "reefs" may thus be described as altered quartzites.

The correlation of the members of the Transvaal system is again taken up by Prof. Schwarz, who attacks the problem in the north of Cape Colony, in Prieska. He has, quite independently, reached the same conclusions as Dr. Molengraaff, and, with certain cautious reservations, passes his comprehensive eye over similar beds in India and North America also. The extraordinary uniformity of deposits in South Africa across enormous areas certainly gives one a new faith in lithological stratigraphy; and it is on this ground that Prof. Schwarz wishes to bring together the two series of ferruginous jaspers in the southern part of the Transvaal, calling in a thrust-plane to his assistance. The general feeling will be, both in our islands and in the Transvaal, that detailed mapping will ultimately bring a just correlation in its train. But detailed geological mapping requires good topographic maps, and the limited resources of the colony seem just now, from a legislator's point of view, to have many prior claims upon them.

Mr. F. P. Mennell shares with the equally energetic Mr. A. J. C. Molyneux the task of elucidating the geological problems of Rhodesia, a region about as large as France, Germany, Austria-Hungary, and Italy put together. The gold problem is naturally the first thing to be investigated, and Mr. Mennell (*ibid.*, p. 82) seeks to correlate the Rhodesian "basket," which he shows to be a true conglomerate, with the gold-bearing series of the Rand at Johannesburg. "So far," however, "it is only at the Eldorado Mine, in the Lomagundi district, that gold has been proved to exist in payable quantities" in the basket of Rhodesia. As Prof. J. W. Gregory recently informed us, other deposits of vein-stuffs may have become known as basket, and it is certainly wise to restrict this term, of Transvaal origin, to the quartzose conglomerates, wherever they occur. In Rhodesia, Mr. Mennell has to deal with a metamorphosed series of sediments, including these conglomerates, and penetrated by ancient and now schistose basic rocks. The widely occurring granite is later than the basic intrusions, and has produced considerable contact-alteration in the entire series. The gold, in

accordance with the view now prevalent for the Rand deposits also, is regarded as a subsequent infiltration.

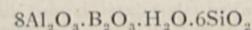
Part ii. of vol. xxxii. of the *Records of the Geological Survey of India* contains Mr. Hayden's "Preliminary Note on the Geology of Tibet," already noticed in this Journal (NATURE, vol. lxxii., p. 285), and Dr. T. H. Holland's paper on the occurrence of bauxite in India. The latter author directs further attention to the aluminous nature of the Indian laterites, and throws the whole field of these rocks open to the prospector. He points out (General Report of the Survey, *ibid.*, p. 142) that the red bauxites of Les Baux were first worked as iron-ores; and in his paper on bauxite the analyses of Indian samples are all from rocks previously known as laterites. A very interesting point is the high percentage of titanium dioxide revealed, and Dr. Holland supports Dr. R. S. Bayer in believing that some unfamiliar and possibly new substance becomes precipitated with the titanium in these cases. Dr. Holland regards bauxite as an intimate admixture of gibbsite, $Al_2O_3 \cdot 3H_2O$, and diaspor, $Al_2O_3 \cdot H_2O$.

Another Indian paper is by Mr. E. W. Wetherell, on the dyke rocks of Mysore (*Mysore Geological Department Memoirs*, vol. ii.), in which a large number of specimens are conscientiously described. The descriptions suffer, however, from the fact that the species of triclinic felspar are not determined. Nor are the misprints so few as the "corrigenda" might lead one to suppose. The drawings for the plates show exceptional care and delicacy.

Mr. G. H. Girty, of the U.S. Geological Survey (*Proc. Washington Acad. of Sciences*, vol. vii., June 20, 1905, p. 1), has instituted a comparison between the Carboniferous faunas of western America and those of Russia and other areas. The ultimate result tends to the increase of the Upper Carboniferous series in America at the expense of beds now classified as Permian. The polyzoan Archimedes, moreover, is shown to possess a far wider range than would be gathered from a consideration of the typical American deposits.

Messrs. Stanton and Hatcher, assisted by Mr. Knowlton, discuss the geology and palaeontology of the Judith River beds, in northern and central Montana and the adjacent parts of Canada (Bulletin 257, U.S. Geol. Survey, 1905). The outcome of stratigraphical study, and the examination of the vertebrate and plant remains, show that these beds are no longer to be regarded as on the Laramie horizon, but are Senonian at the highest, and reach down to the Cenomanian.

The same survey (Bulletin 262) issues contributions to mineralogy, by several authors. The researches on which these careful papers are based arose in connection with the general work of the survey, and the results are here conveniently brought together. Messrs. Hillebrand and Ransome discuss the nature of carnotite (p. 18), which, "instead of being the pure uranyl-potassium vanadate, is to a large extent made up of barium and calcium compounds." From this "mixture of minerals" the true carnotite remains to be extracted and defined. Messrs. Lindgren and Hillebrand (p. 48) incidentally direct attention to the optical properties of chrysocolla, which, though noticed by Jannetaz, have been very generally overlooked. Mr. Schaller (p. 115) gives us a critical analysis of dumortierite, deducing thence the formula



The boron oxide was first indicated by R. B. Riggs in 1887. These are only a few of the matters that will attract mineralogists to these 147 pages.

The surface-features of the glaciated areas of North America have provided a wide field for description and for controversy. Mr. R. S. Tarr has sent us four papers, in which various problems are set forth. That on moraines of the Seneca and Cayuga lake valleys (*Bull. Geol. Soc. America*, vol. xvi., p. 215) is mainly descriptive. The drainage-features of central New York (*ibid.*, p. 229) involve questions of stream-capture, the lowering of water-partings, and the formation of new slopes by detrital deposits, such as delight the glacial expert. A geographical account of the gorges and waterfalls of central New York (*Bull. American Geographical Soc.*, April, 1905) is largely concerned with the relations of pre-Glacial and post-Glacial

valleys. Of still more general interest is the paper on some instances of moderate glacial erosion (*Journal of Geology*, vol. xiii., 1905, p. 160), with its examples of granite boulders lying in a sand derived from their own decay, and left undisturbed by the passage of an ice-sheet over them. The remarkable variations in the intensity of glacial erosion recorded by Dr. Ampferer from the valley of the Inn (*NATURE*, vol. lxxi., p. 236) might be cited in support of the author's observations.

The sixth volume of *Spelunca* is to be devoted to a review and bibliography, by M. E. A. Martel, of all papers on caves published so far in the twentieth century. The first part, issued in June, 1905, covers the papers dealing with France, and the enthusiastic author has spared no pains in making a series of complete and valuable abstracts. The result is a readable work, full of attraction for the geographer as well as the geologist, in which M. Martel devotes most of his own energies to the tracing out of the courses of underground streams.

In the *Geological Magazine* for 1905, Dr. Francis Baron Nopcsa has begun a study of the remains of British dinosaurs, preserved in the collections of the British Museum at South Kensington. He shows that some crocodilian remains are mingled in the rock with those of Polacanthus. The remarkable bony dermal armour and the general skeleton of this dinosaur are figured, and the inflexible union of the lumbar vertebrae is pointed out as a unique feature in this group. The author is, indeed, led to style Polacanthus a sort of glyptodon among dinosaurs.

G. A. J. C.

THE FORTHCOMING INTERNATIONAL CONGRESS OF APPLIED CHEMISTRY.

THE sixth International Congress of Applied Chemistry, already mentioned in *NATURE* (this vol., pp. 322 and 421), will be opened at Rome on April 26 by H.M. the King of Italy. The work of the congress is divided into eleven sections, and in each section an extensive programme has already been organised. Many of the most eminent chemists of Europe and America have promised to attend and deliver papers. Sir Wm. Ramsay will give an address on the purification of sewage, Prof. Moissan will lecture on the distillation of metals, and Dr. A. Frank, of Berlin, on the direct utilisation of atmospheric nitrogen in the manufacture of manures and chemical products. Among the numerous papers which have been received by the committee of the congress, the following may be noticed as possessing general scientific interest:—

Section ii.—The extraction of thorium and cerium from the monazite sands, and their utilisation in Welsbach mantles, by Prof. F. Garelli and G. A. Barbieri.

Section iii. (metallurgy).—The actual state and the future of thermoelectric metallurgy, especially with regard to steel, by Major E. Stassano; report on the state of metallurgy in France, by the Comité des Forges de France.

Section vii. (agricultural chemistry).—Chemical changes during the assimilation of nitrogen by bacteria, by Dr. J. Stoklasa; the significance of the bacterial examination of soils, by Prof. Remy.

Section viii. (hygiene and medical chemistry).—The value of inulin as food in glycosuria, by Prof. C. Ulpiani; our present knowledge of the fats from the standpoint of physiological chemistry, by Dr. A. Jolles; inosuria, by Dr. Meilliére.

Section x. (electrochemistry and physical chemistry).—This section is represented by more papers than any of the other sections. The following may be mentioned:—Certain cases of hydrolysis, by Prof. Véley; the van 't Hoff-Raoult formula, by Prof. W. D. Bancroft; isomorphism and solid solutions, by Prof. Bruni; electrochemistry of non-aqueous solutions, by Prof. Carrara; relations between proteids and electrolytes, by Prof. Galeotti; action of catalysts in the Deacon process for manufacturing chlorine, by Prof. G. M. Levi; silicide of carbon and the calcium carbide industry in France, by Prof. Moissan; catalysis by common metals, by Prof. Sabatier; chemistry of colloids, by Prof. Beckhold; amphoteric elements, by Prof. Le Blanc; toxins and anti-toxins, by Prof. Ehrlich; solid polyiodides of the alkali metals, by Prof. Abegg;

dissociation of fused salts, fused silicates, and glasses, by Prof. Doelter.

The Italian State railways have granted to the members of the congress and their ladies a reduction of about 60 per cent. on the price of an ordinary railway ticket from the frontier to Rome. On their arrival in Rome members of the congress will receive from the committee a book of coupons, which will enable them to obtain at any station tickets at fares reduced by 40 per cent. to 60 per cent., according to the length of the journey. These tickets are available from April 26 until June 11, so that members of the congress may have the opportunity of visiting the International Exhibition at Milan. The subscription fee for membership of the congress is 20 lire for gentlemen and 15 lire for ladies. A special ladies' committee has been formed to receive foreign ladies with the purpose of making their stay in Rome as pleasant as possible.

All inquiries should be addressed to the bureau of the congress, 89 Via Panisperna, Rome

PHYSICAL CONDITION OF CHILDREN IN ELEMENTARY SCHOOLS.¹

THE physical condition of those who are about to enter on active service in the affairs of life, and whose energy is the chief of the national assets, is certainly a matter of great national importance. Every effort is justified in producing as effective a working community as is possible, and Dr. Kerr's report affords welcome evidence of the increasing concern with which those who direct education are regarding the physical conditions of child-life.

During the period dealt with in this report a limited investigation was made of the conditions of some 3500 of the girls and boys attending the Council's schools, and very striking were the results obtained. It was found that some 42 per cent. of these possessed insufficient clothing to retain animal heat, and therefore stood in urgent need of help in this direction; it is not surprising to find that these children were below the average weight of the school for their age; 45 per cent. of those examined had dirty clothes and bodies, and about one-quarter of these were in a verminous condition; here again these children fell distinctly short of the average age weight. The above results tend to show, perhaps, no more than the fact of poverty, although the excessive shortage of weight in the worst clad class of scholars suggests that insufficiency of clothing is a definite factor in producing malnutrition, the insufficient food energy being first taxed to keep up the animal heat.

The greatest effect upon the life capital of the population is produced by the infantile mortality, which in some years actually kills off during the first year one in five of all children born; the question naturally arises, what is its effect upon the survivors? Does the adverse environment which slaughters one in five have a maiming effect upon those left? Dr. Kerr's investigations indicate that the children born in a year when infantile mortality is low show an increased physique, and those born in the years of high infantile mortality show a decreased physique. It appears, therefore, that in the years of high infantile mortality the conditions to which one in five or six of the children born are sacrificed have a maiming effect upon the other four or five.

The examination of the teeth of some 1500 school children demonstrated that, in the case of the boys, some 90 per cent. had caries, and 70 per cent. to a serious extent. Only the boys who had insufficient grinding surface were below the average in physique. It appears, therefore, that caries must be severe to produce an effect on nutrition.

As the result of an examination of the condition of the eyes, it was found that a constant number of about 10 per cent. of scholars have bad vision; and it is estimated that deafness alone is probably sufficient to interfere

¹ "Report of the Education Committee of the London County Council submitting the Report of the Medical Officer (Education) for the Year ended March 31, 1905." No. 922. (London: P. S. King and Son, 1905) Price 1s., post free, 1s. 2d.

to a considerable extent with the educational instruction of at least 5 per cent. of scholars.

The necessity for increased endeavours to obtain better physique is sufficiently obvious to anyone visiting the schools, and it is satisfactory to find that the school exercises are being improved.

Dr. Kerr deals in this report with the question of the exclusion of children from school attendance between the ages of three and five years. He appears to favour the existence of the present state of things, but in this view he will probably not receive much support from medical officers of health. Doubtless school attendance affords facilities for the spread of certain communicable diseases (70 per cent. of the infants under five who are at present admitted to the Council's schools have not yet had measles or whooping-cough), and the advantage to the child of postponing attacks from these diseases for even a year or two is so great that it offers one strong argument in favour of excluding children under five from school attendance. Dr. Kerr states that children learn more in the years three to five than they will learn in the same period at any time subsequently. But in children between three and five the reasoning from what they see and hear is very slight indeed, and in the opinion of many the child does not really stand in need of school-teaching before it reaches the age of five.

Increasing solicitude is shown in regard to the personal cleanliness of the children attending the public elementary schools, and Dr. Kerr discusses some of the problems underlying the difficult question of dealing with underfed children. The nurses working under the Council are accomplishing a highly important work of considerable educational value in examining for cases of ring-worm, vermin, and unwholesomeness, and in many cases they follow up their school work by home visits. In connection with the campaign now being carried on in favour of personal cleanliness in schools, the provision of school washing-baths, as distinct from swimming arrangements, is becoming increasingly necessary in many parts of London.

The more important facts dealing with infectious disease in this report relate to the subjects of diphtheria and measles. From the result of much observation and many carefully recorded facts, Dr. Kerr concludes that when a school becomes a source of infection it is generally found that the cases of diphtheria are connected with a class or classes in which the average age of the children is between five and eight. Rarely do cases below five or above eight become sources of infection, and never has it happened in the investigations that a class the average age of which is less than four or above ten has been found to be acting as a disseminating centre. These classes appear to become sources of infection because the children at these ages have the power of partial resistance to the onslaught of diphtheria bacilli, and a large proportion of them are capable of attending school while suffering from slight attacks. Dr. Thomas, the assistant medical officer, in a valuable report upon measles and school closure, concludes that in London at present the disease only spreads in classes under five years of age, except in certain better-class districts, and that to effect any useful purpose school closure must take place before the "first crop" falls. The old practice of waiting until the attendance fell to a certain limit was useless in arresting the spread of measles, and did absolutely no good.

STUDIES OF NATIVE TRIBES.

THE American ethnological work in the Philippines is making steady progress. The first part of vol. iv. of the publications has just appeared. It deals with Moro history, law, and religion. Mindanao and Sulu were conquered in the Middle Ages by Mohammedans, who established a new form of government and introduced a written code of laws. Previous to this there was no written history, but thenceforth the datus or chiefs kept their genealogies, and these, brief though they be, are the only sources for Moro history. Prior to the American acquisition of the islands the *tarsila* or genealogies were rigidly

kept out of sight of all foreigners and non-Mohammedans, but the Ethnological Survey has been successful in getting copies of many of them; these have now been translated, and are published in the volume before us. The Moros comprise various tribes, which differ as considerably as the Ilocano and the Igorot; the language is Malayan, but the characters employed are Arabic, which makes the work of transliteration no easy one. Some pages of the codes are published here in facsimile; the genealogies are reproduced in the ordinary form, and an exact translation of the genealogy and commentary is also given. There are introductory sections, but perhaps it would have been well to add explanatory notes to the translations in addition.

In vol. xxxix. of the Proceedings of the Royal Society of New South Wales, and also in the Journal of the Geographical Society of Queensland for 1905, Mr. R. H. Mathews maintains (1) that Australian tribes do not practise exogamy; (2) that the eight clan tribes trace descent through the mother; and (3) that there is a cross-division, cutting through phratries and classes, in the eastern tribes. His first and second points are based on the alleged possibility of marriage with any woman of the same generation. His third point, confirmed by Dr. Howitt ("Native Tribes," p. 106 n.) in some measure, may be correct, but seems to point rather to totemic exogamy within the phratry. Mr. Mathews would do well to give (1) the names of all correspondents, and (2) actual genealogies, so that his statements can be verified. He should also explain the object of phratries and classes, if they are not regulative by marriage; success in this would greatly strengthen his case. His researches, if correct, are subversive of much that has been written of late years, but he cannot expect the anthropological world to accept his unsupported statements. If anthropology were officially recognised by the British Empire, evidence on the point would soon be forthcoming. As it is, only untrained observers are available, and much reliance cannot be placed on them.

POLONIUM AND RADIO-TELLURIUM.

SINCE the discovery of polonium—the first radio-active substance investigated by Madame Curie—much doubt has existed as to its true nature and as to its relationship with radio-tellurium, subsequently separated by Prof. Marckwald from radio-active bismuth salts. Several papers which have recently been published throw considerable light on the problem, without, however, giving to it a definite solution. Madame Curie (*Physikalische Zeitschrift*, No. 5) has determined the constant of decay characterising her "polonium," and finds that it is practically identical with that ascribed by Prof. Marckwald to his radio-tellurium; in both cases the activity falls to half its value in about 140 days, so that there can be little doubt that the two substances are identical. In discussing the chemical properties of "polonium," Madame Curie concludes that there is no ground for considering that it more closely resembles tellurium than bismuth. In No. 4 of the *Berichte* of the German Chemical Society, Prof. F. Giesel has investigated the radio-activity of a " β -polonium" which differs from the older polonium or radio-tellurium by its emitting β rays instead of α rays; the activity of this substance falls to half its value in 6.14 days. This value does not correspond with the rate of decay of any of the known degradation products of radium. Meyer and von Schweidler, on the other hand (Proceedings of the Vienna Academy of Sciences, February 1), have obtained a radio-active bismuth which appears to behave as a mixture of radium D, radium E, and radium F; but Madame Curie (*Physikalische Zeitschrift*, No. 6), in discussing this result, considers that polonium cannot be identical with radium D or radium E, but only with radium F. Closely connected with these researches must be mentioned an investigation by Prof. H. Becquerel (*Physikalische Zeitschrift*, No. 6) of some of the characters of the α rays emitted by radium, and by substances rendered active by radium.

MEDITERRANEAN FEVER.¹

THE reports of the commission for the investigation of Mediterranean fever, part iv., recently issued, contains a number of important papers. It is shown that in 86 per cent. of patients the *Micrococcus melitensis* is present in the peripheral blood, but usually not in large numbers (Staff-Surgeon Gilmour, R.N.), that it can be recovered from most of the organs and tissues *post mortem*, and from the urine, but not from the saliva (Captain Kennedy, R.A.M.C.). A critical examination of the blood for the agglutination reaction, by Fleet-Surgeon Bassett-Smith, R.N., shows that the blood in 148 cases, other than Mediterranean fever, gave an agglutination reaction only in four. The four latter had recently returned from Malta, and, though suffering from other affections at the time, had had the fever. The agglutination test is therefore perfectly trustworthy. Three papers deal with the possible propagation of the disease by insects. Mosquitoes, *Culex pipiens* and *Stegomyia fasciata*, were proved to be capable of carrying infection; in one case it was highly probable that a human being had been infected in this way, and experimentally one monkey was thus infected (Major Horrocks and Captain Kennedy). In view of the observations recorded in a previous report of the natural infection of goats with the *M. melitensis*, the further investigations in this direction are of great interest. Major Horrocks and Captain Kennedy find that 41 per cent. of the goats in Malta are infected, and that 10 per cent. supplying milk excrete the *M. melitensis* in their milk, and monkeys and goats can be infected by feeding with the infected milk. Cows, bullocks, mules, and in one instance a dog, are other animals proved occasionally to be infected. Like goats, cows may transmit the micrococcus in their milk (Staff-Surgeon Shaw, R.N., and Captain Kennedy). These results suggest that a very important source of human infection is from domestic animals, particularly *via* milk. Ambulatory cases in man and the excretion of the micrococcus in the urine are also sources by which infection may be transmitted both to man and animals.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

At the University of Messina, Profs. G. Bagnera and E. Bortolotti have been appointed to chairs for higher analysis and calculus respectively.

At the annual graduation ceremonial of the University of St. Andrews, on Tuesday, the honorary degree of LL.D. was conferred upon Dr. A. C. L. G. Günther, F.R.S., Prof. J. Cook Wilson, professor of logic in the University of Oxford, and Prof. A. H. Young, professor of anatomy in Victoria University, Manchester.

At Lehigh University a course in electrometallurgy has been established. In its main outline it is similar to the course in metallurgy, but differs from it in omitting assaying and geology. The time thus gained is devoted to electrical engineering. There are thus two courses of four years each offered in the department of metallurgy.

SOME interesting data relating to the heating of university buildings are contained in a paper by Mr. H. W. Spangler in the Journal of the Franklin Institute of Philadelphia (vol. clxi., No. 3), in which he describes the system of heating and lighting the dormitories of the University of Pennsylvania from a central station about 1200 feet away.

IN addition to the Clift-Courtauld and Pfeiffer scholarships to be awarded in June, the council of Bedford College for Women offers a Deccan scholarship in science, value 60*l.*, for three years, on the result of the entrance scholarships examination. The scholarship will be awarded only to candidates who wish to qualify themselves to earn a

living, and cannot obtain their university education without pecuniary help.

A PRIVATE view of the exhibition of students' work will be held at the Borough Polytechnic Institute on April 7. In view of the attention which is being directed to the work done on the Continent and in America in the direction of industrial training for apprentices, many men of science interested in educational problems may be glad to learn more of the work of an institute which has made industrial training, combined with a good educational foundation, one of its strongest features.

A PRELIMINARY meeting in connection with the second International Congress on School Hygiene, to be held in London in August, 1907, was held at the University of London on March 30. Sir Lauder Brunton, F.R.S., president of the congress, announced that French educationists and medical men have determined to do all in their power to make the congress in London a complete success, and other countries have taken the matter up. A gratifying reception has been accorded to the idea of an international congress both in Canada and in South Africa, and it is hoped that at the congress there will be a thoroughly representative gathering, not only of the colonies, but of every civilised country in the world. The congress, Sir Lauder Brunton said, promises to be one of the largest and most important ever held in London. Resolutions were adopted approving the idea of holding the second congress in London, asking the King to extend his Royal patronage to the congress, approving the steps already taken to initiate the arrangements for the congress, and inviting the cooperation of educational and municipal authorities, societies, and other representative bodies interested in education and the health and development of children during school life.

THE annual dinner of the Bristol University College Colston Society was held on March 30. The president, Mr. J. W. Arrowsmith, announced the receipt of a cheque for 500*l.* from Lord Strathcona, who was unable to attend. He added that for the past six years an anonymous donor has sent the college 100*l.* annually for its sustentation fund. The Hon. Mrs. Whittuck, of Bath, has offered 1500*l.* to form part of the endowment of a chair of economic science, provided the council of the college sees its way to establish such a chair. It has been determined to take up in earnest the task of establishing a university for Bristol, and a committee has been formed, covering the counties of Wiltshire, Somerset, and Gloucestershire. Lord Winterstoke has offered 10,000*l.*, Mr. J. S. Fry 10,000*l.*, and Sir Frederick Wills and Mr. F. J. Fry 500*l.* each, thus making up 30,000*l.* Altogether from 150,000*l.* to 200,000*l.* are wanted. Mr. Whitelaw Reid, the United States Ambassador, and Mr. Birrell, President of the Board of Education, both responded to the toast of "Our Guests." Mr. Reid described American experience in the founding of universities. The people of the United States began by copying Oxford and Cambridge, the only two English universities in 1833; but in time they found that the demands of a new people, and of a continent that had to be subdued to the uses of civilisation, called more and more for some higher education of a different kind. Thus while the great English schools still adhered chiefly to the humanities, theirs began a divergence, which every year found more decided, towards science and its applications. The most notable tendency as yet in recent higher educational development in America is towards scientific and technological study with a specialisation always growing more precise, if not also more narrow, in reference to the student's intended pursuits in life.

After describing the development of schools and institutions of higher education since the Civil War, Mr. Reid went on to say that none of these schools has money enough, though many of them have considerable amounts. First, of course, stands the Leland Stanford with its princely endowment, from one man and his wife, of between seven and eight million pounds. Next comes Columbia with more than six million pounds, then Harvard with about five and a half millions, Chicago with nearly four millions, and Cornell with nearly three. The great work of Yale has been done with true Connecticut

¹ "Reports of the Commission appointed by the Admiralty, the War Office, and the Civil Government of Malta for the Investigation of Mediterranean Fever, under the Supervision of an Advisory Committee of the Royal Society." Part iv. Pp. 187. (London: Harrison and Sons, 1906.) Price 3*s. 6*d.**

thrift, since they cannot yet count up quite two millions of pounds; and that of Johns Hopkins, briefer but also great, has been achieved with an endowment of little above one million. The Carnegie Institute at Washington has two millions. Many of the other institutions of higher learning are far less adequately provided for; but in general it may be said that the Republic is more liberal with its schools than with anything else. In no other field do its private citizens display more generosity, and as for public expenditure, to give but one illustration, it may be mentioned that the single State of New York spent in 1905 from the public treasuries, State and local, for its schools in the neighbourhood of nine million pounds.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, December 7, 1905.—“On the Influence of Bias and of Personal Equation in Statistics of Ill-defined Qualities: an Experimental Study.” By G. Udny **Yule**. Communicated by Prof. O. Henrici, F.R.S.

To attempt to answer the question raised by the results of the preceding investigation an experiment was conducted, by asking observers to classify under such headings as “light,” “medium,” “dark,” scraps of photographic paper printed to different depths of colour. The results show that (1) personal equation in the use of such terms is very large indeed; (2) the majority of observers tend to return an excess of pairs of tints of the same name; (3) the amount of this excess is increased when different observers’ results are pooled, owing to their varying personal equations; (4) but it is markedly less than the excess of the number of homonymous pairs (as compared with a normal distribution) in several of the tables for inheritance of qualities. The answer to the question remains therefore somewhat indefinite, and further investigation is required.

Chemical Society, March 15.—Prof. R. Meldola, F.R.S., president, in the chair.—The interaction of well-dried mixtures of hydrocarbons and oxygen: W. A. **Bone** and G. W. **Andrew**. The results of experiments carried out chiefly with well-dried mixtures of ethylene and oxygen indicate that steam is not essential to the combustion of hydrocarbons.—The explosive combustion of hydrocarbons: W. A. **Bone** and J. **Drugman**. The results of this research indicate that there is no essential difference between the slow and rapid combustion of a hydrocarbon, and that explosive combustion probably involves the initial formation of unstable hydroxylated molecules, which subsequently undergo thermal decomposition into simpler products.—The occurrence of methane among the decomposition products of certain nitrogenous bases as a source of error in the estimation of nitrogen by the absolute method: P. **Haas**. The author confirms and extends to a large number of substances Dunstan and Carr’s observation that in the Dumas method of determining nitrogen in organic substances an error may be caused by the inclusion of marsh gas in the gas collected and measured.—Studies on comparative cryoscopy, part iv., the hydrocarbons and their halogen derivatives in phenol solution: P. W. **Robertson**.—The displacement of acid ions, part i.: A. F. **Joseph**. The author describes his investigations on the quantitative action of hydrochloric acid on the nitrates of potassium, sodium, and strontium, and of nitric acid on the corresponding chlorides.—Additive compounds of arylamines with aromatic nitro-derivatives: C. L. **Jackson** and L. **Clarke**. 4:6-Dibromo-1:3-dinitrobenzene dimethylaniline, 4-chloro-1:3:5-tribromo-2:6-dinitrobenzene dimethylaniline and other similar additive products are described.—Influence of substituents in the trinitrobenzene molecule on the formation of additive compounds with arylamines: J. J. **Sudborough** and N. **Pictor**. The formation of additive compounds between *α*- or *β*-naphthylamine and *s*-trinitrobenzene derivatives is completely inhibited by the introduction of three methyl-, two methoxy-, or three bromo-radicals into the trinitrobenzene molecule.—The relations between absorption spectra and chemical constitution, part iv., the re-activity of the substituted quinones: A. W. **Stewart** and E. C. C. **Baly**. An examination was made of the

absorption spectra of various quinones, and conclusions are drawn as to the conditions in which these substances exist.—The constitution and properties of acyl thiocyanates: J. **Hawthorne**.—A mode of formation of aconitic and citrazinic acids and their alkyl derivatives, with remarks on the constitution of aconitic acid: H. **Rogerson** and J. F. **Thorpe**.—Aromatic sulphonium bases: S. **Smiles** and R. **Le Rossignol**. Two methods of preparing aromatic sulphonium bases are described, (1) from a sulphonide and phenetole with a dehydrating agent, (2) from a sulphinic acid and phenetole with strong sulphuric acid.—A new form of calcium chloride tube for combustion: A. E. **Hill**. This tube is described and illustrated in the current number of the Proceedings of the Chemical Society, 1906, xxii., 87.—The viscosity of liquid mixtures, part iii.: A. E. **Dunstan**.—The action of phenylpropiolyl chloride on the ketonic compounds, part ii.: S. **Ruhemann**.

PARIS.

Academy of Sciences, March 26.—M. H. Poincaré in the chair.—The methods used in the search for luminous particles mixed with the gas of the chromosphere and the solar protuberances. Application during the eclipse of 1905: H. **Deslandres**. The lines due to the gases are readily observed, but the continuous spectrum due to the presence of liquid or solid particles is much more difficult to recognise. The author attacked this problem during the last eclipse, making use of coloured screens to remove the gaseous radiations. A preliminary account of the results is given.—Observations on Gennadas: E. L. **Bouvier**. The author draws the following conclusions from his work in this and a preceding paper on the same subject: the Gennadas are clearly bathypelagic, and do not descend to live at great depths; they do not rise to the surface for reproduction, and are derived from Bentheisicus by adaptation to a bathypelagic existence.—Quasi-waves of shock in the midst of a fluid which is a good conductor of heat: P. **Duhem**.—The Oligocene basin of Ebro and the Tertiary history of Spain: Ch. **Dépérèt** and L. **Vidal**.—The total eclipse of the sun of August 30, 1905; solar protuberances of two colours: J. **Esquirol**.—A magic square: G. **Tarry**.—The theory of characteristics: E. **Goursat**.—Discontinuous ensembles: L. **Zoretti**.—The development of non-integrable functions in trigonometrical series: P. **Fatou**.—Hyperelliptic surfaces defined by intermediate singular functions: Louis **Remy**.—The deformation of the metals of a railway: G. **Cuénat**.—A mode of construction of aeroplanes allowing of an increase, in notable proportions, of their sustaining power: E. **Seux**.—The evaluation of the power of microscopic objectives: L. **Malassez**.—The variations of the absorption bands of a crystal in a magnetic field: Jean **Becquerel**. The spectrum of xenotime, a uniaxial crystal giving fine absorption bands, was obtained with a Rowland grating, and the effect of placing the crystal in a magnetic field examined. The resulting displacement of some of the bands was much greater than would be expected from the magnitude of the ordinary Zeeman effect in metallic vapours.—Gaseous osmosis through a colloidal membrane: Jules **Amar**. A perfectly dry colloidal membrane is impermeable to carbon dioxide; the gas diffuses through only when the membrane is moist, and the amount diffused diminishes progressively as the membrane dries.—A contribution to the study of the intermittent discharge: G. **Milloc'hau**.—New researches on bulbs producing X-rays: M. **Nogier**.—The use of the Cooper-Hewitt lamp as a source of monochromatic light: Ch. **Fabry** and H. **Buisson**. This mercury arc lamp, which is now made commercially, gives a light of uniform intrinsic lustre. The yellow and green rays are so fine as to give interference phenomena with a difference of path of 22 cm., that is to say, of an order of about 490,000. The yellow rays give particularly fine results.—The isolation and some atomic characters of dysprosium: G. **Urbain**. The author has isolated 50 grams of an earth the spectral characters and atomic weight of which show such constancy among the different fractions that it is impossible to imagine that it is a mixture. Details of the methods of separation used and the spectrum observed are given.—The commercial preparation of calcium hydride: Georges F. **Jaubert**. The product, as put on the

market, contains about 90 per cent. of calcium hydride, the remainder consisting chiefly of oxide and nitride. One kilogram of this, when acted on by water, gives about a cubic metre of pure hydrogen. The lifting power of this being about 1200 grams, calcium hydride has been already used in aéronautics.—The action of the xanthic leucamines on copper: N. **Slomnesco**.—A new type of equilibrium reaction: L. J. **Simon**. The equilibrium studied was the reaction between urethane and pyruvic acid.—Practical details in the estimation of cadmium: H. **Baubigny**.—The estimation of the albumenoid material in milk: MM. **Trillat** and **Sauton**. The method is based upon the property of formaldehyde of rendering the milk albumenoids insoluble without affecting their weight. The working method is given, and also control analyses.—The catalytic action exercised by alkaline and alkaline-earth salts in the fixation of atmospheric oxygen by solutions of polyphenols: E. **Fouard**.—The formation and distribution of the terpene compounds in the bitter orange: Eug. **Charabot** and G. **Laoue**.—A parasite of the pearl oyster determining the production of fine pearls at the Gambier Islands: L. G. **Seurat**. The parasite is named *Tylocephalum margaritiferae*, and, owing to its pearl-forming properties, is of considerable economic importance.—The origin of the nerves: N. A. **Barbieri**.—Haematoxin and the formation of haemoglobin: L. **Hugounenq** and Albert **Morel**.—Aseptic hyperthermia due to operations: MM. **Charrin** and **Jardry**.—A contribution to the history of the Piedmont geosynclinal: Émile **Argand**.—A contribution to the physical geography of the Atlas chain of Morocco: Louis **Gentil**.

DIARY OF SOCIETIES.

THURSDAY, APRIL 5.

ROYAL SOCIETY, at 4.30.—On Retardation of the Discharge of an Electroscope by Means of certain Radio-active and other Substances: Dr. W. S. Lazarus-Barlow.—On a Mineral, which retards the Rate of Discharge of an Electroscope: Dr. E. H. Büchner.—On a New Method of obtaining Continuous Currents from a Magnetic Detector of the Self-Restoring Type: L. H. Walter.—On the Distribution of Radium in the Earth's Crust, and on the Earth's Internal Heat: Hon. R. J. Strutt, F.R.S.—On the Physiological Action of a recently discovered African Arrow Poison: Dr. C. Bolton.

CHEMICAL SOCIETY, at 8.30.—An Improved Apparatus for measuring Magnetic Rotations and obtaining a Powerful Sodium Light: W. H. Perkin, Sen.—The Rusting of Iron: G. T. Moody.—In the Determination of Carbon in Soils: A. D. Hall, N. H. J. Miller and N. Harmer.—The Electrolysis of the Salts of $\beta\beta$ -Dimethylglutaric Acid: J. Walker and J. K. Wood.—Bromo- and Hydroxy-derivatives of $\beta\beta\beta$ -Tetramethylsuberic Acid: J. K. Wood.—Some new Orthoxylene Derivatives: G. Stallard.—A new Solvent for Gold. Preliminary Note: J. Moir.—The Molecular Condition in Solution of Ferrous Oxalate: a Correction: S. E. Sheppard and C. E. K. Mees.

ROYAL INSTITUTION, at 5.—Internal Combustion Engines: Prof. B. Hopkinson.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Electrical Equipment of the Aberdare Collieries of the Powell Duffryn Company: C. P. Sparks.—Electric Winding considered Practically and Commercially: W. C. Mountain (*Conclusion of Discussion*).

LINNEAN SOCIETY, at 8.—Exhibition: Some Plants new to the pre-Glacial Flora of Great Britain: Clement Reid, F.R.S.—Papers: A Second Contribution to the Flora of Africa.—Rubiaceæ and Compositeæ, Part II.: Spencer Moore.—The Anatomy of the Stem and Leaf of *Nyctis floribunda*, R.Br.: E. J. Schwartz.—Taiwanites, a new Genus of Conifera from the Island of Formosa: B. Hayata.

CIVIL AND MECHANICAL ENGINEERS' SOCIETY, at 8.—Steam Turbines: G. D'A. Meynell.

FRIDAY, APRIL 6.

MALACOLOGICAL SOCIETY, at 8.—On a Species of the Land Molluscan Genus *Dyakia* from Siam: Lt.-Col. H. H. Godwin-Austen, F.R.S.—Descriptions of new Species of Land Shells from Peru and Colombia: S. I. Da Costa.—Note on Swainson's Genus *Volutilithes*: R. Bullen Newton.—Further Notes on the Genus *Chloritis*, with Description of new Species: G. K. Gude.—*Vertigo parcedentata*, Braun, in Holocene Deposits in Great Britain: A. S. Kennard and B. B. Woodward.

ROYAL INSTITUTION, at 9.—The Physical Basis of Life: W. B. Hardy, F.R.S.

GEOLOGISTS' ASSOCIATION, at 8.—The Pressure-chipping of Flint, and the Question of Eolithic Man: S. H. Warren.

SATURDAY, APRIL 7.

ROYAL INSTITUTION, at 3.—The Corpuscular Theory of Matter: Prof. J. J. Thomson, F.R.S.

THE ESSEX FIELD CLUB (at Essex Museum of Natural History, Stratford), at 6.30.—Salt-making in Essex, Ancient and Modern: Miller Christy.—Neolithic Man in Epping Forest: F. W. and H. Campion.

MONDAY, APRIL 9.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Presentation by H. E. the American Ambassador of the Gold Medal of the American Geographical Society to Captain R. F. Scott, Commander of the National Antarctic

Expedition.—Paper: Recent Exploration and Survey in Seistan: Col. Sir Henry McMahon, K.C.S.I.

VICTORIA INSTITUTE, at 4.30.—The Bible in the Light of Modern Science: W. Woods Smyth.

TUESDAY, APRIL 10.

ZOOLOGICAL SOCIETY, at 8.30.—The Freshwater Fishes of the Island of Trinidad, based on the Collection, and Notes and Sketches, made by Mr. Lechmere Guppy, Jun.: C. Tate Regan.—The Marine Fauna of Zanzibar and British East Africa from Collections made by Cyril Crossland in the Years 1901-2. Alcyonaria: Prof. J. Arthur Thomson and W. D. Henderson.—(1) Cyclopia in Osseous Fishes; (2) Notes on Supernumerary Eyes, Local Deficiency and Reduplication of the Notochord in Trout Embryos: Dr. J. F. Gemmill.

INSTITUTION OF CIVIL ENGINEERS, at 8.—On the Resistance of Iron and Steel to Reversals of Direct Stress: Dr. T. E. Stanton and L. Barstow.

FARADAY SOCIETY, at 8.—Note on the Rotating Electric Steel Furnace in the Artillery Construction Works, Turin: E. Stansano.—Electro-thermics of Iron and Steel: C. A. Keller.—Recent Developments in the Gin Electric Steel Furnace: G. Gin.—Note on the Cleaning of Work by Means of the Electric Current: H. S. Coleman.

WEDNESDAY, APRIL 11.

ROYAL ASTRONOMICAL SOCIETY, at 5.

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