THURSDAY, MARCH 11, 1909.

MODERN GEOGRAPHY.

Geography, Structural, Physical and Comparative. By Prof. J. W. Gregory, F.R.S. Pp. viii+305. (London: Blackie and Son, Ltd., 1908.)

A Text-book of Geography. By G. Cecil Fry. Pp. xx+406. (London: W. B. Clive, University Tutorial Press, Ltd., 1908.) Price 4*s.* 6*d.*

WE learn from the preface to the first of these works that the book is intended for use in schools, and as it is likely to be much read, we take this opportunity of pointing out certain features which, in our opinion, are open to criticism, and might be reconsidered when a second edition is called for. In the first place it does not appear that sufficient care has been exercised in distinguishing between universally accepted generalisations and more or less tentative hypotheses. The frontispiece, only very briefly referred to in the text, is a case in point; it depicts the distribution of land and sea as it existed at some past epoch not specified, and in the absence of a word of warning is only too likely to be mistaken for a truthful record of observations. In reality it is to a large extent imaginary, and to render it a faithful representation of the existing state of our knowledge its bands of colour, so boldly and uniformly washed in, should be diversified by thickly sprinkled notes of interrogation.

The letterpress is divided into four parts, the first of which treats of the structure and the materials of the earth. This would have been an excellent summary had it not been marred by the introduction of doubtful hypotheses and unqualified statements which by their baldness become of questionable truth. Thus in explanation of a new term, "fluidable," invented by the author, we read (p. 5):—

"This term expresses the fact that though the internal material of the earth is rigid in the sense that it resists compression like a solid, it changes shape under pressure as readily as a fluid."

Again, on p. 9 we read, "The earth therefore is not an oblate spheroid. In fact it is not a spheroid at all. . . ." and in the next chapter we pass to the so-called tetrahedral theory of the earth. The speculation this involves is in itself so crude that we fail to understand on what grounds it was selected as the only true representation of the facts, especially as other views had been formulated long previously. The admirable analysis by Prof. Love is referred to in an appendix, but in a manner which awakens a suspicion as to how far the author rightly appreciates its significance.

Part ii. treats of "Earth forms and how they are made." It is extremely sketchy, and contains many doubtful statements. The elevation of a part of New Zealand in 1855 was certainly accompanied by an earthquake, but there is no evidence to show that it was caused by one. The thorny question of isostasy is not a subject for schoolboys, and should be treated more fully or not at all. The diagram of an earthquake wave (Fig. 32) is unintelligible as it stands, that of a volcano (Fig. 33) crude and misleading.

The fragments of topographical or hydrographical charts, introduced as examples of morphological types, are not to be compared with those of some recent American text-books. It is also unfortunate that there seems to be no consistent scheme of graphic representation; in the two adjacent maps on pp. 52 and 53, for instance, the shaded parts represent sea in the one and land in the other; in each isobaths might have been introduced instead of the sporadic numbers, which are confusing even to the eyes of an expert. Part iii. is devoted to climate, including an incomplete account of the winds, but not rain, and ocean currents. Why this amount of meteorology and hydrography should have been introduced and so much of equal importance omitted is not clear; in any case, the little that is given might have been correct; there is a strange blunder on pp. 84 and 85, where the explanation of land and sea breezes is accompanied by two diagrams, in each of which the wind is represented as blowing *into* a region of high pressure.

The bulk of the work is contained in part iv., which includes a laudable attempt to popularise the study of structural geography, based chiefly on the unfinished work of Suess. In the presumed ignorance of geology on the part of the reader, recourse is had to a phrase—"the grain of the land"—which is made to perform a task almost greater than it can bear. Thus the map of the British Isles inserted at p. 102 is scored with red lines, corresponding to various heterogeneous features all of which are to be referred to "the geological grain." Not only the Caledonian and the Armorican folds are thus represented, but the posthumous axis of the Isle of Wight, and even the Cotteswold and Chiltern hills, which are really sculptural rather than structural features.

The simple diagram on p. 128 is of very doubtful utility, and the more elaborate scheme in plate xvi. is open to more serious criticism. The European plain, left white, is shown extending from central Russia through North Germany, Holland, and the middle of the British Isles as far west as county Clare, from which the schoolboy will either infer that the Pennine chain, Snowdon, and the Wicklow hills are negligible inequalities, or else suffer from a confusion of ideas. On the same map, Scotland and Scandinavia are designated the "Archean Plateau of North-Western Europe." Plateau is a term rather oddly applied to either the Scottish Highlands or the mountains of Norway, unless in a very remote palæographical sense. Further south the fragments of the Armorican and the Variscan mountains are coloured differently from the central massif of France, although on the new geological map of France (scale 1 : 100,000) the connection of the trend-lines of Auvergne with those of South Brittany on the west, and, through the gneissose outliers of La Serre, with that of the Vosges

on the east, is perfectly evident, and, as is well known, the connection has been confirmed by deep borings. The Spanish Meseta, notwithstanding its family likeness with the other fragments of the Armorican system, is also differently coloured. The manner in which the trend-lines of this area are drawn fails to express the true structure of Spain; as a matter of fact, the Carboniferous basin of the Asturias forms the centre of a nest of Hercynian folds, interrupted to the north by the Bay of Biscay, and diverging to the south-east like confocal parabolic curves. Tertiary lacustrine deposits sometimes obscure the facts, but otherwise they are clear enough.

The Tertiary mountain systems are represented very diagrammatically by thin red lines which are sometimes difficult to interpret, as, for instance, in the neighbourhood of Mont Blanc, where an hitherto unknown syntaxis is shown. The chain of the Apennines is marked in a different colour from its continuation to the west in the Alpes Maritimes, or to the south through Sicily into the Atlas. But by far the most remarkable feature on the map is the trend-line drawn almost straight from Cyprus to Baku. As regards the true structure of Asia Minor, reference may be made to a paper by E. Naumann (*Geographische Zeitschrift*, 1896, vol. ii., pl. i.). The author himself does not seem quite confident as to this line, for in the next structural map (Asia, pl. xix.) it is no longer shown as extending to Baku, but takes a sharp turn to the east and joins the Pontic arc.

A defect in the sense of proportion which is too characteristic of the work is nowhere more manifest than in Fig. 83, a section through eastern Asia, in which the depth of the Tuscarora abyss is represented as at least equal to the breadth of the Manchurian step, and the only reference to scale is the remark that the breadth of Japan is exaggerated.

The illustrations to the anthropological descriptions are of very unequal value; many are very poor, but the worst is probably that of a Polynesian (Fig. 97), which is badly selected, and is not good even as a caricature. The Eskimos are said to be of Mongolian origin, but modified by the arduous conditions of their life in the frozen north. We should like to know more about the influence of the environment, and especially how it came to confer upon the Eskimos their long heads. We are told in equally direct terms that the Australians are Caucasians who have been modified by adaptation to life in the arid region of Central Australia—a statement open to question from more than one point of view.

There is much that is meritorious in this work; it is certainly interesting, and if equally trustworthy would be deserving of high praise.

As regards the work by Mr. G. C. Fry, there is much less to be said; it seems intended to meet the requirements of an examination syllabus, and is probably well adapted to this purpose. The geological sections (Figs. 50 and 51) should be withdrawn, or replaced by better ones, such as almost any geological text-book will afford.

A HANDBOOK OF INORGANIC CHEMISTRY. Handbuch der anorganischen Chimie. Edited by Dr. R. Abegg and Dr. Fr. Auerbach. Bd. ii., Abt. i. Pp. xiii+867. (Leipzig: S. Hirzel, 1908.) Price 24 marks.

THREE earlier parts of this handbook of inorganic chemistry have already received commendatory notice in NATURE (vol. lxxvii., p. 25). The present one constitutes a further gratifying addition to chemical literature, and calls for the same cordial welcome that was extended to its predecessors. It deals with the first group of elements in the periodic system, the various members being treated individually as follows:—Hydrogen (Baur); lithium (Auerbach and Brislee); sodium, potassium, rubidium, cæsium (Hinrichsen); copper (Donnan); silver (Baur); gold (Wohlwill). In addition to the general treatment of the elements and their compounds by these authors, certain sections are dealt with by separate contributors: atomic weights (as in the preceding volumes) by Brauner, and colloidal chemistry, so far as it concerns the substances coming within the scope of the present volume, by Lottermoser and Donnan; this section is a new feature of the work.

Since the rate of progress has not, so far, quite come up to original intentions, Prof. Abegg has now appointed as co-editor Dr. Auerbach, of the Imperial Public Health Department, in order that the publication of the remaining volumes may be expedited.

Prof. Brauner's contributions are especially important in the case of the present volume; he has elected to deal here, not only with the individual elements included in it, but also, collectively, with the "fundamental" atomic weights—those of the seven elements sodium, potassium, silver, chlorine, bromine, iodine, with oxygen, of course, as standard. This takes up fifty pages of the book, and provides an excellent critical *résumé* of the older as well as the recent work on the subject; the atomic weight of hydrogen, treated separately, is also very fully dealt with.

In the various descriptive sections a vast amount of important matter is collected, and particular prominence is, of course, given to the results of modern physicochemical investigation. This is particularly the case with copper and its compounds; in this section, which is easily the largest, and is in some respects the most important, in the volume, electrical matters naturally bulk largely.

It is impossible to enter more fully here into the many good points of the book; taking these for granted, a few words of criticism may perhaps be allowable. The aim of Prof. Abegg and his collaborators has avowedly been to treat the subject more particularly from the modern physicochemical standpoint, and they have therefore omitted much that one would look for in a handbook of inorganic chemistry which followed the usual lines. One cannot help thinking, however, that in places this process has been carried too far. For example, much more information might surely have been given concerning the reactions involved in the Leblanc soda-process, to which less than a page (p. 297) is devoted. The pre-

paration of salt cake is dismissed in a single equation (which is arithmetically incorrect) as if it took place in one stage only; not a word is said about the formation of acid sulphate, or about the reverse action of hydrochloric acid on sodium sulphate, nor is the matter dealt with under either sodium chloride or the sodium sulphates. Then there is a discrepancy between the statement here, regarding the reduction of sodium sulphate, and that on p. 270; according to the former, the action is represented by the equation

$$Na_2SO_4+2C=Na_2S+2CO_2,$$

and the formation of carbonic oxide is due to the later interaction of coke and calcium carbonate; according to the latter, the reduction of sodium sulphate produces carbonic oxide, though the action is complicated by the formation of some carbonic anhydride.

In connection with the description of processes for manufacturing soda, a curious slip of quite a different kind is made. On p. 298 there occurs the statement :—

"Es ist daher wohl nur eine Frage der Zeit, wann dieses Verfahren [ammonia process] den Leblanc-Prozess vollständig verdrängt haben wird."

And then, three lines further down :—

"In neuester Zeit endlich wird auch das Solvay-Verfahren durch die direkte Sodagewinnung aus Kochsalz mittels des elektrischen Stromes in den Hintergrund gedrängt."

There is an undesirable lack of precision about statements such as that on p. 432, that rubidium persulphate has been prepared "by electrolytic oxidation of a saturated solution of the sulphate in presence of sulphuric acid." Here and there, also, there is room for criticism regarding inconsistency in the formulæ used to represent elements in some of the equations. On p. 681, in connection with the action of chlorine on silver nitrate, the chlorine appears in the equation as $3Cl_2$, but on p. 690, in the equation for the precisely analogous action of bromine, this appears as 6Br. In equations to represent actions which involve "nascent" hydrogen, it would be better to avoid using the molecular formula H_2, which appears on p. 91.

Throughout the whole book, however, the occasions for criticism are gratifyingly few in number.

MECHANICAL ENGINEERING.

(1) *Lathe Design for High- and Low-Speed Steels.* By Prof. John T. Nicolson and Dempster Smith. Pp. x+402. (London: Longmans, Green and Co., 1908.) Price 18*s.* net.

(2) *Mechanics of Engineering.* By Prof. Irving P. Church. Revised edition, partly re-written. Pp. xxvi+854. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1908.) Price 25*s.* 6*d.* net.

(3) *Motor-car Mechanism and Management.* Part ii. *Electric and Petrol-electric Vehicles.* By W. Poynter Adams. Pp. x+202. (London: Chas. Griffin and Co., 1908.) Price 5*s.* net.

(1) THIS treatise is based largely upon two important pieces of research work carried out by the authors at the Manchester Municipal School of Technology—the one on the durability of tool steel, the other upon the cutting forces acting upon lathe tools; these researches have been published already in the form of reports; the practical side of the book is also based upon data and particulars furnished to the authors by machine-tool makers.

The book is, therefore, a successful attempt to supersede the empirical rules which have hitherto governed the design of these machine tools, and to substitute for them methods based upon experimentally ascertained facts; the general adoption of high-heat steel had, in fact, rendered obsolete much of the accumulated data of the tool-maker, and some change in methods of design was therefore essential, and, in offering a solution of this problem, the authors have fully realised that the economic or commercial side of the question must be taken into account as well as the scientific.

The first few chapters are devoted to an account of the authors' experiments, already alluded to, the results being given in tabular form and in the form of curves; the experimental results so obtained are then applied to the design of lathes for high-speed cutting and for low speeds, and for what the authors term compromise lathes also; such problems as greatest and least spindle speeds, number of speeds, and the belt drive are fully discussed.

In chapters xix. to xxi. the principal designs of the fast headstock and its gear arrangements are described, both when the cone is mounted on the spindle and when it is off it, and also when the cone is replaced by a single pulley, and all variations of speed are obtained by gearing. Then follow chapters devoted to the general principles which underlie the choice and design of such fast headstocks, the chapter devoted to the design of power gears and their teeth being an especially valuable one for the designer of machine tools. To the main spindle and its design three chapters are assigned, and every important feature in regard to their construction is fully discussed, especially in regard to frictional losses and the means for reducing them. The feeding mechanism to the saddle, and reversing mechanism for feed motions, are dealt with in a succession of chapters, in which a perfect store of information has been brought together; for a general-purpose lathe, the authors state that four to six turning feeds meet all ordinary practical requirements; this section of the book is followed by that which treats of the feeding mechanism on the saddle, a special chapter being devoted to the problem of such feeds in heavy lathes; all this section of the book is well illustrated with reproductions of photographs of complete lathes, and of working drawings, often fairly fully dimensioned, of the particular part of the mechanism under discussion.

In chapter xxxiv. the application of the experimental data obtained by the authors to the problem of feed mechanism design is fully explained. The design of saddles and rests, the loose headstock, and the lathe bed are all discussed in detail, and in connection with the lathe bed it is shown that the proper form to give the section is the box or circular, the lathe beds of

ordinary design being weak to resist the torsional moments to which they are subject. The last chapters are devoted to the cost of machining and the factors which govern it, to the construction of the "characteristic" diagram for any given headstock, and the means of measuring from it the economic value of the design. In the last chapter, by way of illustration, the authors show the application of the torque-speed diagram, and the lathe characteristic to a series of selected lathes built by well-known makers.

The book will be indispensable to the lathe designer, and to the manufacturer who employs large numbers of these machine tools; it is an admirable example of the way in which scientific research in our engineering schools can be applied to advance and improve the great manufacturing industries of the country.

(2) This is a revised edition, in part re-written, of Prof. Church's well-known text-book on the mechanics of engineering. The book is divided into two sections, one dealing with the mechanics of solids, the other with the mechanics of fluids, and a separate index has been provided for each section; the first section is again divided into three parts: the first part treats of statics, the second kinetics, while the third and most important part, covering 320 pages, deals with the subject of the strength of materials.

The chief changes in the subject-matter in this edition are confined to certain chapters on the strength of materials, and to portions of the section treating of the mechanics of fluids. An important new chapter is that devoted to the flexure of reinforced concrete beams, a subject of much interest to engineers engaged in structural design; the author considers that for purposes of practical design it may be assumed that, as in homogeneous beams, cross-sections, plane before flexure, remain plane when the beam is slightly bent; this assumption is only valid if the modulus of elasticity of concrete is constant in value; this is not so, but, as the author points out, it does not vary much in value within the limits of stress to which such reinforced beams are subjected in good design work.

Other useful fresh matter is that contained in chapters xii. and xiii.; in the former the subject of the flexure of simple and continuous beams is treated from the geometrical standpoint; that is, algebraic relations are deduced from the known properties of certain geometrical figures; this leads to a very simple and available form of the three moments theorem; in the latter there is a concise and lucid discussion of the relations between stress and strain in thick cylinders. In the section of the book dealing with hydraulics, the chief additions are those describing new appliances, such, for example, as the Cippolletti or trapezoidal weir, the Venturi meter, and the differential manometer.

Text-books dealing with the mechanics of engineers are constantly being consulted by practical men, who wish to refresh their memory in regard to the theory of some particular problem which they meet with in their professional work, and for this purpose a very complete index is essential. In any further re-issue of this work, it would be a distinct improvement if the indices were made more thorough and complete.

(3) As in part i., this book is divided into two main sections, one dealing with the mechanism of the car, the other with its management, and, in addition, there is a brief general introduction on the subject of electricity. As the book is intended rather for users of cars than for builders, the description of the car mechanism has been written in such a way that any intelligent non-technical reader should have little difficulty in appreciating the important points to which attention must be paid in design, and as to which the buyer must also be able to satisfy himself before deciding to purchase an electric car. In dealing with the management of the car, the author describes two forms of brake suitable for the measurement of the power of the motor, but he does not describe the simpler rope brake, which is much more satisfactory for such tests than the Prony friction brake, especially if, instead of a rope, a thin, hollow, flat band of metal is used through which a constant stream of water can be circulated to absorb the heat generated by the friction.

Special attention has been given to the management of the battery, since success in driving an electric car depends so much upon the manner in which the battery is handled. In regard to the cost of running in London an electric car, fitted with pneumatic tyres, the author estimates that it will average with a good driver 2·92*d.* per car mile, the cost of the electric energy only amounting to 0·12*d.*, wear and tear of tyres accounting for 1·5*d.*, depreciation of battery for 1·2*d.*, the other expenses amounting to 0·1*d.* The last chapter of the book is devoted to petrol-electric vehicles, that is, to vehicles which combine with the motor and controller equipment of an electric car a petrol engine and a dynamo driven by it to supply electricity to the motor; this system possesses certain important advantages, and is being applied with success to commercial vehicles and omnibuses.

As soon as the battery problem is solved, the electric car will, at any rate for town use, rule supreme—but we are a long way yet from solving that problem. T. H. B.

BIOLOGY FOR TEACHERS.

First Course in Biology. Part i., Plant Biology. Pp. xxv+204, and 302 figures; Part ii., Animal Biology. Pp. 224, and 408 figures; Part iii., Human Biology. Pp. 164+x, and 132 figures. By L. H. Bailey and W. M. Coleman. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1908.) Price 7*s.* 6*d.*

THIS book hails from across the Atlantic, and aims at supplying a course of work intermediate between unorganised nature-study and the formal science of the more advanced courses. The general intention of the authors is:—

"To lay greater stress on the processes and adaptations of life as expressed in plants and animals and men, and to attach less importance to botany, zoology and physiology as such."

It is certainly well that teachers should do their utmost to prevent that study of botany which leaves the student ignorant and indifferent to the plants

arcund him, or of that physiology which does not lead to healthy living. The book appears to be intended for teachers rather than for students; but it is not very conveniently arranged. A certain amount of information is given on each topic handled, but usually not enough for a teacher who has not already considerable knowledge of the subject; and a number of questions is asked, often in a style that is almost irritating: *e.g.* "Which senses are very acute? Why? Dull? Why?"

But apart from matters of taste in style, it would be better to separate the volleys of questions from the descriptive text. The unfortunate teacher attempting to get up his lesson has now to wade through dozens of unanswered queries in order to pick out from them a few morsels of information scattered here and there over many pages of text. On the other hand, the trained and experienced teacher will derive few, if any, new ideas as to method, though he will probably welcome the excellent coloured diagrams.

The plants and animals examined are for the most part those which find place in the elementary courses in vogue in this country; but there are, of course, frequent allusions to American species. Of the three parts contained in the volume we prefer that devoted to human biology. In this part, information and questions are kept distinct, and the standard is just what is wanted for instructing pupils in the healthy working of the human body and for emphasising the importance of cleanly and active habits.

The pages are not entirely free from error. Etymologists will be startled to learn from Mr. Bailey (p. 60, part i.) that "parenchyma=parent+chyma, or tissue." We are tempted to inquire what derivation he would invent for "prosenchyma," and would venture to recommend a study of the Greek prepositions. Similarly, we question whether "batrachia" can be rightly translated "twice breather"; certainly the word is not synonymous with amphibia (p. 127, part ii.). The statements on p. 172, part ii., concerning migration are inaccurate; nor is it correct to state that the ferments (or enzymes) present in the digestive juices are "vegetable substances" (p. 100, part iii.). The figure (219) on p. 116, part ii., is that of a lamprey, not of an eel as stated in the legend.

O. H. L.

OUR BOOK SHELF.

Schlich's Manual of Forestry. Vol. V., Forest Utilisation. By W. R. Fisher. Pp. xii+840. (London: Bradbury, Agnew and Co., Ltd., 1908.) Price 12*s.* net.

WITH the appearance of this edition the whole subject of forest utilisation is brought thoroughly up to date. Prof. Fisher has given to English readers an admirable translation of what may be recognised as the best work on the subject. The German edition is itself based on Gayer's "Forstbenutzung," which was for many years the standard work, but with the lapse of time a new up-to-date edition became necessary to bring the book into touch with modern experience and practice. The task of writing a new edition was undertaken by Prof. H. Mayr, a former pupil of Gayer, and at present his successor in the chair of forest utilisation in the University of Munich.

The volume is divided into four parts. Part i. deals with the principal forest produce, wood, in relation to its harvesting, conversion, and disposal. Part ii. treats of minor forest produce, its properties, utilisation, value, and disposal. In part iii. is considered the utilisation and disposal of the minor produce from the soil of the forest, while in part iv. the utilisation of the components of the forest soil, such as stone, gravel, &c., is given, and at the end we have a very useful index.

The whole work is profusely illustrated, and in this edition the number of illustrations has been increased by 73, making a grand total of 402, together with 5 full-page plates.

Of the several volumes which constitute Schlich's "Manual of Forestry," this one is probably the most complete in the treatment of its subject. The various parts are divided into chapters, and these, again, into sections, each section containing a clear and concise account of the subject or operation with which it deals. The student as well as the practical forester will find this volume a regular mine of information. This work will be found equally useful in Britain, our colonies, and elsewhere, as it deals with forest utilisation in its broadest sense. In fact, the authors have made use of all the available research of the nineteenth century in bringing the work up to date. The German work naturally gives most prominence to German matter, although at the same time taking into consideration that of other countries. The translator has added to this, and based the work on a still broader foundation, in order that it may be applicable wherever the English language is spoken.

This volume is sure to be appreciated by a large number of forest-owners and foresters all the world over, and it can be confidently recommended as the best and most exhaustive work dealing with the important and world-wide industry of forest utilisation.

Parallel Paths: a Study in Biology, Ethics, and Art. By T. W. Rolleston. Pp. xv+299. (London: Duckworth and Co., 1908.) Price 5*s.* net.

THE author contributes this thoughtful book towards "the establishment of a spiritual view of the universe on a natural basis." He believes that there is more in life than chemical and physical forces. The "living machine" that we hear so much about "differs essentially from other machines in not being a machine at all, or anything in the least like one." In support of his vitalistic position, the author refers in a lucid way to the difficulty of giving any chemico-physical interpretations of development and adaptability. "The master-word is nature's will to live." He considers the Lamarckian position and abandons it, noting, for instance, that if bodily characteristics acquired by exercise were transmissible by inheritance, the new-born child of right-handed ancestry ought to show some appreciable preponderance in weight and size of the right over the left limb. But he is not satisfied with Weismann's explanation either, though he admires the brave attempt to steer between the Scylla of Lamarckism and the Charybdis of "metaphysics." All evolution theories assume the responsive powers of protoplasm. But what does it respond to? If, as Weismann says, "the response is only to differences in the amount of nutriment obtainable by the various determinants of the germ-cell, and has only a fortuitous connection with the results attained," then how can we interpret adaptations such as that of the fish, Anableps, with its bifocal eyes? Thus the author is led to "a directive

theory of evolution," somewhat like that of the botanist Reinke. Man, the growing-point of progressive life, is conscious of directive control. Is there anything more real and certain to him, and is it not the x factor in all life and evolution? "The master-word is nature's will to live," and as man is not an outside observer of the universe, but an organic part of it, the author goes on to show, in very interesting chapters, that ethics is for life, and that art is man's expression of life. J. A. T.

A Course of Pure Mathematics. By G. H. Hardy. Pp. xvi+428. (Cambridge: University Press, 1908.) Price 12*s*. net.

THE title of this book is rather a misnomer. As a matter of fact, the most interesting part of it is in the last two chapters, which contain an excellent discussion of the logarithmic and exponential functions based upon the definition of $\log z$ as an integral. The preceding eight chapters deal with real and complex variables, limits, convergence of series, and the fundamental theorems of the differential and integral calculus. They are chiefly interesting as an illustration of the fact that there is a growing number of university teachers who are resolved that, if they have to teach elementary calculus, they will do it in the most rigorous way that they can, exposing the fallacies which used to be calmly ignored. There is a large number of examples, many of which show how much more attention has been given of late years in Cambridge to the elements of general function-theory. Mr. Hardy's book is more likely to be regarded as a work on the calculus than anything else; as such, it will be a useful companion to such treatises as those of Lamb and Gibson. M.

Clay Modelling in Manual Training from Plan, Elevation, and Section. By F. W. Farrington. With an Introduction by J. W. T. Vinall. Pp. 47; plates xl. (London: Blackie and Son, Ltd., 1908.) Price 3*s*. net.

Clay Modelling in Manual Training. Scholars' Handbook. (Same publishers.) Intermediate and Senior, plates xl., price 4*d*. net. Junior, plates xvi., price 3*d*. net.

ANY practical pursuit which leads to a scientific training of the hands and eyes of young pupils should receive encouragement in the schools; and modelling in clay can, in the hands of a skilful teacher, become a very useful aid in teaching several subjects. Mr. Farrington indicates how clay modelling may assist school teaching in arithmetic and geography, but hardly develops sufficiently these and similar practical applications of this form of manual work. The books will serve to provide young teachers and pupils with helpful guidance.

Handbook to the Technical and Art Schools and Colleges of the United Kingdom. Compiled from Official Information. With an Index to Courses of Instruction. Pp. xii+140. (London: Scott, Greenwood and Son, 1909.) Price 3*s*. 6*d*. net.

THIS useful directory of some of the most important schools and colleges in the British Isles providing instruction in science, technology, and art gives information as to the governing authority, principal, and secretary of each of the institutions dealt with, and particulars as to the courses of instruction arranged at each centre. Though comprehensive, the directory is not complete, and it may be hoped that the request made by the publishers for data of schools omitted will be complied with by the respective authorities, so that the omissions may be rectified in the second edition.

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.*]

Ionisation in the Atmosphere.

THE apparatus designed by Ebert has been widely used to determine the total charges per c.c. of the positive and negative ions in the atmosphere. Except under unusual conditions, the measurement of the positive charge exceeds that of the negative charge by an amount very variable, which averages perhaps about 20 per cent. Thus the ratio of the charges has an average value not far different from the ratio of the mobilities of the ions or from the ratio of their coefficients of diffusion.

The apparatus consists of a metal cylindrical testing vessel with an insulated axial rod connected with the central system of an electroscope. Air is drawn through the testing vessel at a known speed by a small turbine driven by clockwork. The quantity of electricity received by the central charged rod is determined from a knowledge of the electrical capacity and observations of the loss of potential.

The following simple experiments by Mr. F. W. Bates and the writer led to unexpected results. A large hollow cone of cardboard was placed so that the air entering the testing vessel all passed through the cone, and the air during its passage was strongly ionised by the β and γ rays of radium, or by the γ rays alone. The instrument itself was well screened from the rays, and the radium bromide (14 mg.) was carefully sealed in a test-tube so that no emanation escaped. The position of the radium was varied, so that the number of ions detected in different experiments covered a wide range.

Assuming the value of the ionic charge to be $3{\cdot}4\times10^{-10}$ E.S.U., and supposing that every ion carried unit charge, then the values obtained, after necessary small corrections, gave the following average number of ions per c.c. :—

Series	Positive ions	Negative ions	Ratio
1 ...	37,570	34,300	1·09
2 ...	19,900	10,100	1·99
3 ...	22,320	16,820	1·33
4 ...	14,350	11,850	1·21
5 ...	7,280	5,800	1·25
		Mean	1·39
Without radium	1,280	1,050	1·22

The variation in the ratio may be due to changes in the humidity or to the presence of dust.

The main point is, however, strongly marked. Whilst the γ rays of radium produce equal quantities of positive and negative electricity when they ionise gas in a closed vessel, we find that on ionising air near Ebert's apparatus there appears to be a large excess of positive electricity.

Care has been taken in designing the apparatus to avoid an external field. Since negative ions are under almost all conditions more mobile than positive ions, we should expect the negative ions to be captured more readily than the positive in the testing vessel, unless, indeed, some of the positive ions had a double charge. Again, it is possible that a large number of the negative ions diffuse to the top and sides of the testing vessel before entering it. In that case the diffusion is unexpectedly rapid. Moreover, the ratio, positive to negative, remained unchanged when the air was drawn through an earthed wide-meshed wire cylinder, when the loss by diffusion of the negative ions might be expected to show a relative large increase.

The details require further investigation, but the main and important result seems to be well established, namely, that the Ebert apparatus, and others of like type, are misleading in indicating a large excess of positive over negative electricity in the atmosphere. Thus when observers have recorded the average ratio as 1·2 there may really have existed equality, and the apparent excess may be due to the inequality of the rate of diffusion of the two

kinds of ions, dependent on and varying with atmospheric conditions, such as humidity.

The recent interesting work of Townsend proves that under some conditions the positive ion may have a double charge, two negative ions appearing at its formation. Hence it is possible that in the atmosphere a newly generated positive ion may for a short time be the more mobile, and the apparent excess of positive electricity may not improbably be traced to this cause, as some preliminary experiments seem to indicate. Even if that is so, the fact remains that the quantities of positive and negative electricity in the atmosphere do not differ, at least not to the large extent usually recorded. A. S. EVE.

Montreal, February 17.

The Absorption of X-Rays.

THE results of experiments that have been made by a number of investigators on the absorption of X-rays, secondary X and γ rays, are so complicated by a variety of conditions that few general conclusions can be drawn from them. It is apparent that a knowledge of the simple laws governing the absorption of X-rays, and the emission of secondary rays, would in many cases enormously simplify the explanations, and save much fruitless labour.

By the use of homogeneous beams of X-rays, and by a study of secondary X-rays, we have been enabled to arrive at the following conclusions:—

Many elements—possibly all—when subject to a suitable Röntgen radiation emit at least one homogeneous beam of X-radiation, which is characteristic simply of the substance emitting it.

When a radiation which is of more absorbable type than the radiation characteristic of a certain substance is incident on that substance, it does not appreciably excite that characteristic secondary radiation.

When the incident radiation is of more penetrating type than that characteristic of the exposed substance, that characteristic secondary radiation is excited.

The absorption of the radiation not sufficiently penetrating to excite the homogeneous secondary radiation characteristic of an absorbing element is governed by very simple laws, the ratio of the absorption coefficients in elements A and B (say) being constant. That is, λ_A/λ_B is approximately a constant for any radiation experimented upon which is not more penetrating than the radiation characteristic of A or B.

When the incident radiation is of more penetrating type, the absorption is greater than would be given by this law, additional absorption being evidently essential to the emission of the characteristic secondary radiation. As the general penetrating power of the incident radiation increases, the intensity of secondary radiation increases, and the absorption by this particular element increases, and finally for more penetrating primary rays the intensity of secondary radiation and absorption of primary rays decrease again in the ordinary way.

The beam emerging from the absorbing plate consists of a weakened primary beam proceeding in its original direction, a little scattered radiation, and a homogeneous radiation uniformly distributed (except for internal absorption). There is no evidence of any other kind of transformation—speaking purely of X-rays.

We may, therefore, by a proper choice of primary radiation and absorbing element observe any of the following:—

(1) Incident and emergent beams of identical penetrating power.

(2) Incident beam, homogeneous; emergent beam a mixture of two homogeneous beams, the ratio of the intensities of which asymptotically approaches a constant value, as the thickness of the absorber increases.

(3) Incident beam, homogeneous; emergent beam a mixture of two, the radiation of incident type ultimately vanishing and leaving a completely transformed radiation.

A homogeneous radiation from an element appears specially penetrating to that element and to elements of neighbouring atomic weight, because it is of less penetrating type, or only just more penetrating than the radiations from these elements.

The change in the character of an ordinary heterogeneous beam of X-rays in transmission through an element is due to (1) the general selection of rays of the more absorbable type; (2) the special selection of those rays of greater general penetrating power than the radiation characteristic of the absorbing substance; (3) the emission of secondary rays, which are more generally absorbable than the radiations which produced them, but which may be more penetrating to the element emitting them.

The energy of primary radiation transformed into secondary rays is so great that the secondary X-rays proceeding from the antikathode of a Röntgen tube constitute a considerable portion of the heterogeneous beam.

Many of Mr. Kaye's experiments on so-called primary rays, for example, are obviously experiments on secondary rays, verifying our previous results. A comparison of the absorption coefficients shows the identity of the two.

A fuller treatment of the subject of absorption will shortly be published. We wish, however, to point out the great simplification that results from the application of these simple laws to many of the phenomena which have recently been described in a variety of papers on X-rays and secondary X-rays. Probably the laws may be extended to include also the γ rays.

C. G. BARKLA.
C. A. SADLER.

University of Liverpool, March 5.

The Rays of Uranium X.

IN continuation of the work published in a letter to NATURE of January 28, p. 366, I have now carried out under more favourable conditions a second series of observations designed to detect the growth, if any, of a feeble α radiation during the decay of the intense β radiation of uranium X. I used the preparations, obtained from 50 kilograms of uranyl nitrate, employed by Mr. Russell and myself in the study of the γ rays (NATURE, March 4, p. 7). The preparation was placed 1·6 cm. from the thin aluminium foil, forming the base of an electroscope, in a magnetic field of 10,800 units, so that no β rays with a value for $H\rho$ less than 8640 could enter the electroscope.

Under these conditions, although the β radiation from the preparation was sufficiently intense to show luminosity on an X-ray screen in a fully lighted room, the leak in the electroscope was small enough for accurate measurement. About one-fourth of the leak was due to γ rays, and the remainder to still undeflected β rays. Initially the leak was not measurably altered by covering the preparation with a layer of thin tin foil sufficient to absorb any α radiation. In a few hours after preparation a decided difference was noticed, pointing to a growth of α radiation from the preparation, as the considerations outlined in my previous letter had led me to expect. Instead, however, of this absorbable radiation growing with the time according to the function $1-e^{-\lambda t}$, where λ is the radio-active constant of uranium X, contrary to all expectation the absorbable radiation *very quickly* reached a maximum, and has since remained constant. About one-half the maximum was reached after the lapse of one day, while after 2·5 days no further increase was observed. At this stage the absorbable radiation was about one-fifth of the total.

The observations have now been in progress for one month. These observations and the whole of those previously made indicate that this α radiation remains constant after the maximum is reached over a period of several years. This points to the existence of a new body, presumably somewhere in the uranium series, with a period of the order of one day, the product of which gives α rays, and has a very long period of life.

I have thought it well to record these observations before being in a position fully to explain them, as there has just come to hand the announcement by M. Danne (*Le Radium*, February, p. 42) that, working with 20 kilograms of uranyl nitrate, he has succeeded in effecting the partial separation of the parent of uranium X, which he terms *radio-uranium*. From his description it appears that the new body is very closely allied to uranium in chemical nature. So far as can be judged, it appears improbable that in preparing the uranium X for these experiments any of the radio-uranium was separated. One may conclude at

once from M. Danne's results that the period of radio-uranium must be long compared with that of uranium X. Thus M. Danne's discovery neither assists nor makes it more difficult to explain the results recorded in this letter. It is obvious that we have here really a very complex series of changes not capable of immediate interpretation.

FREDERICK SODDY.

Are the Senses ever Vicarious?

IT is a prevalent opinion that if a human being is bereft of one sense, one or more of the other senses become more acute, and thus establish a compensation. For example, it is generally believed that the blind have the senses of touch and of hearing, more especially of touch, developed to a degree of acuteness not found in those who see, and that, in this way, the blind find their way about the world with an accuracy that is often surprising. The blind have even been credited with the ability to discriminate colours by the sense of touch, and some have attempted to support this supposition by an appeal to the sense of heat or cold possibly, for physical reasons, associated with a particular colour. A compensating arrangement has also been attributed to the deaf, and more especially to the deaf-blind. Such notions, however, must be abandoned before the evidence of recent investigations.

The question is discussed with much shrewdness in a paper on the physiology of the blind, by M. Kunz, director of the Institution for the Blind at Illzach-Mülhausen. He refers especially to the observations of Prof. Griesbach, made on a considerable number of blind persons in the Mülhausen Institution, and also, for the sake of comparison, on pupils in the public schools of Mülhausen of the same age. The results are somewhat surprising. As regards perception of the direction of sound, there is no difference between the seeing and the blind. The average distance at which sounds could be heard was essentially the same in both classes. As tested by Zwaardemaker's olfactometer, the delicacy of the sense of smell was rather in favour of the seeing. Griesbach used his own æsthesiometer, with parallel pins on springs, instead of the old Weberian method with compasses, in testing the acuteness of touch, with the result that the average minimum distance, say on the tip of the forefinger, &c., at which two points were felt was greater in the blind than in the seeing; in other words, that the seeing had a finer sense of touch than the blind. It is generally supposed that the palp of the forefinger of the right hand, which is used by the blind in feeling the points in Braille's system of teaching the blind to read, must be very sensitive, but this was found not to be the case. Too high a degree of sensitiveness to touch is rather unfavourable to discriminating the points in Braille's type, and it is curious that when, in the blind, the epidermis of the skin covering the right forefinger becomes thickened by manual labour or by laborious practice in "reading," the discrimination of the points becomes easier. It was observed, also, that sometimes in the blind there was a difference as regards receiving impressions between the two forefingers.

There appears to be no evidence, therefore, that blindness, *per se*, increases the sensitiveness of the other senses, but, on the principle that if one sense is defective the others are likely to be also defective, the other senses, in the average blind, are less acute than in the seeing. How, then, are we to explain the wonderful way in which the blind avoid obstacles and find their way about? It has been supposed that by practice the skin of the face, in particular, becomes more sensitive, or, in other words, that the blind habitually pay attention to currents of air playing on their faces, and especially they may be influenced by sensations of temperature. They say that they "know" they are near a wall because they "feel" it, although they do not touch it. It would be interesting to examine the blind as regards the sensitiveness of the hot and cold spots of the skin revealed by Goldscheider and others. The theory of sensitiveness to the direction and temperature of air currents is supported by the observation that the blind do not so readily avoid an obstacle if the face is covered or even if they are blindfolded. This suggests the question: Are all so-called blind people absolutely insensitive to light?

It is also believed that the blind pay an almost involuntary attention to the direction and quality of sounds. The blind man "taps" his stick. When snow is on the ground the blind have difficulty in avoiding obstacles. One must not forget, however, the psychical element that enters into the question. The effort of attention is superadded to the sensory impression. Impressions may reach the sensorium of which we are usually unconscious, but they may be detected by an effort of attention. This was strongly pointed out by Helmholtz. The senses of the blind are not more acute than those of normal people, but the necessities of the case oblige the blind to pay attention to them.

JOHN G. MCKENDRICK.

The Zoological Position of Tarsius.

Two years ago (NATURE, May 2, 1907, pp. 7 and 8) I directed attention to the fact that the recent additions to our knowledge of the Primates would compel us to look upon this order as being composed of three diversely specialised phyla of subordinal rank. It seemed clear that we should have to adopt some such subdivision of the Primates as that employed by Gadow ("A Classification of Vertebrata," London, 1898, pp. 52 and 53), who called the three suborders Lemures, Tarsii, and Simiæ respectively.

The researches of Hubrecht had shown that in respect of certain phases in its developmental history Tarsius differs from the lemurs and resembles the apes, and, as the result of the examination of its brain, I had come to the conclusion that Tarsius is much more primitive, and at the same time distinctly more pithecoid, than the lemurs (Linnean Society's Journal, 1903). But Hubrecht would interpret these facts (see NATURE, December 24, 1908, p. 229) as a demand for the exclusion of the lemurs from the Primates. The memoirs published within recent years by Forsyth Major, Earle, Standing, and the writer have made it perfectly clear that the demonstration of the affinities of Tarsius to the apes does not in any way affect the recognition of the fact that it is at least as nearly related to the lemurs, so that Hubrecht's proposal to restrict the term Primates to Tarsius and the apes lacks any adequate justification.

At the last meeting of the British Association I pointed out that the results of stimulation of the brain in lemurs and the examination of the distribution of the histologically distinct cortical areas by Page May, Wilson, and myself, had revealed a close resemblance to the condition found in the apes. In opposition to the views of Vogt, Brodmann, Halliburton, and Mott, we found that a true sulcus of Rolando—which is peculiarly distinctive of the Primates—showed a tendency to develop in every prosimian family, and that in the lemur Perodicticus the morphology of the cerebral hemisphere is identical in almost every respect with that of the American monkey Pithecia. These facts bear unmistakable witness to the right of the lemurs to be included in the Primates.

In a monograph on the human hair by Friedenthal, a curious distinctive feature of the distribution of the hair in the Simiæ is mentioned. This author states that in man and all the other Primates (among which he does *not* include the lemurs) the sole of the foot is absolutely devoid of hair, not only in the adult, but also in the fœtus, and the line of demarcation between the hairless and the hairy skin runs across the back of the heel; but in the Prosimiæ the posterior part of the sole of the foot is coated with hair. I have examined a series of specimens of Tarsius given to me by Dr. Charles Hose, and find that in the manner of distribution of the hair on the foot Tarsius differs from the apes and agrees with the lemurs. At a time when so much weight is being attributed to facts of relatively slight significance on the other side, it seems worth pointing to this curious straw of evidence, which shows that, as the Primate stream flowed from its source among a group of Tarsius-like mammals, the apes and the lemurs were merely divergent branches of this stream, and that the latter suborder, although definitely specialised in structure, remained nearer to the Tarsii than the apes.

Cairo, February 17. G. ELLIOT SMITH.

Number of Molecules in Unit Volume of a Gas.

THE following is an attempt to calculate the number of molecules of helium in unit volume directly, that is, without assuming Avogadro's hypothesis and the known value of the number of molecules of any gas per unit volume.

Various methods can be adopted leading to the five results given below :—

(*a*) Meyer, in his "Kinetic Theory of Gases," has calculated the molecular free path of helium at 0° and atmospheric pressure to be $L=24\times10^{-6}$ cm. ("Kinetic Theory of Gases," p. 194, second edition).

Now let Q = sum of the diametral sections of the spheres of all the molecules contained in unit volume, then, by the formula

$$Q=1/4\sqrt{2}L \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

we calculate Q for helium = 7402 sq. cm. nearly.

It is also proved in treatises on the kinetic theory that $S=6\sqrt{2}\nu L$, where S = radius of the sphere of action of the molecule, ν = space actually occupied by the molecules contained in unit volume or the coefficient of condensation. Now this coefficient of condensation is always less than the ratio E of the densities of the substance in the gaseous and liquid states, so that, putting E for ν in the above formula, we shall get the superior limit to the value of S. We have then $E_{Helium} = \Delta/\delta$, where Δ, δ are the densities of helium in the gaseous and liquid states. Putting $\delta=0{\cdot}15$ (Onnes), we have

$$S_{He}=2{\cdot}4\times10^{-7} \text{ cm.} \quad . \quad . \quad . \quad . \quad . \quad (2)$$

(*b*) This value is probably high, and Meyer has shown that a method involving deviations of the gas from Boyle's law is more accurate. Onnes gives the value 0·0007 for b in van der Waals's equation for helium (quoted in NATURE, October 22, 1908, p. 635). Accordingly, assuming Maxwell's relation $b=4u$, where u = co-volume or volume actually occupied by the molecules per unit volume, we get the known formula $S=(3/\sqrt{2})pbL$, where p = pressure in metres of mercury, for which the value of L which is employed holds good. We have, then,

$$S_{He}=2{\cdot}5\times10^{-8} \text{ cm. nearly} \quad . \quad . \quad . \quad (3)$$

(*c*) Adopting the relation $b=4\sqrt{2}u$ instead of Maxwell's, we get

$$S_{He}=1{\cdot}76\times10^{-8} \text{ cm. nearly} \quad . \quad . \quad . \quad (4)$$

This calculation has, it seems, a claim to greater accuracy, since the relation $b=4\sqrt{2}u$ has been confirmed experimentally by Holborn (Exner's Report, 1891, xxvii., p. 369) and by Sydney (*Chem. News*, 1898, lxxviii., p. 200).

(*d*) Calculating S_{He} by another method, which has been found, in many cases, to give an inferior limit to the value of S from the formula $g=(\mu^2-1)/(\mu^2+2)$, where g = fraction of the volume containing the gas which its molecules actually occupy, and μ = index of refraction. Hence, replacing ν by g in Loschmidt's formula, we have

$$S=6\sqrt{2}gL.$$

Taking data from the paper by Cuthbertson and Metcalfe (Phil. Trans., A, vol. ccvii., p. 138, 1907), we get

$$g=\tfrac{3}{8}(\mu-1)=37\times10^{-6}$$

nearly, whence

$$S_{He}=0{\cdot}5\times10^{-8} \text{ cm. nearly} \quad . \quad . \quad . \quad (5)$$

(*e*) Lord Kelvin found that there must be from 200 to 600 molecules in the volume of one wave-length of the light emitted by the body. Taking the lower limit, 200, the mean distance between molecules is found to be

$$x=5\times10^{-3}\times5876\times10^{-8} \text{ cm,} \quad . \quad . \quad . \quad (6)$$

If N = number of molecules per unit volume, we find

$N_{He}=0{\cdot}017\times10^{19}$ nearly from (1) and (2)
$=1{\cdot}4\times10^{19}$,, (1) and (3)
$=2{\cdot}8\times10^{19}$,, (1) and (4)
$=36\times10^{19}$,, (1) and (5)
$=4\times10^{19}$,, Equ. (6) . $N\lambda^3=1$.

Comparing these values of N for helium, we see that the value obtained from the density of liquid helium is very low, whereas the refractivity method gives a very high value. Greater accuracy seems to belong to those obtained from van der Waals's equation; of these two, the latter value obtained from $b=4\sqrt{2}$ is probably the best. Hence, no doubt, it is safest to adopt $2{\cdot}8\times10^{19}$ as the value of N. It is interesting to compare with this the value of N as obtained by Rutherford and Geiger from their recent counting experiment (NATURE, November 5, 1908, p. 14), viz. $N=2{\cdot}72\times10^{19}$.

P. GHOSE.

Physical Laboratory, Presidency College, Calcutta, January 14.

An Electromagnetic Problem.

I AM glad to get Mr. Campbell's views (NATURE, January 21) on the electromagnetic problem which I submitted (NATURE, November 19, 1908). His method of going back to fundamental definitions is, of course, in general the only safe way where any doubt may enter.

His remarks, however, considered as an answer to my question, are not quite to the point. As I carefully stated in the original letter, I am not desirous of setting up a conservation of energy paradox, but merely wish to show that apparently *the ordinary expression* for the energy of any electromagnetic field is, in the present case, not in harmony with the first law of energy. The accepted expression for the energy in any electromagnetic field is

$$\frac{1}{8\pi}\int\left(E^2+H^2\right)d\tau,$$

where E is the force in dynes on a unit stationary test charge, H the force in dynes on a unit stationary "magnetic pole," and $d\tau$ is the element of volume. The test charge and pole are not parts of the system.

This expression for the energy does not appear to remain constant while the sphere of electricity is allowed to expand under the mutual repulsion of its parts, for the magnetic force on the test pole is obviously always zero, while the region of integration for E^2 is constantly diminishing. The difficulty, then, is with this *generally accepted expression* for the energy, and this is the only difficulty to which I refer. D. F. COMSTOCK.

Institute of Technology, Boston, Mass., February 10.

I AM sorry if I have misunderstood Prof. Comstock, but many others besides myself thought that he maintained that the difficulty vanished in some way if the distribution of the electrification on the sphere was discontinuous. My letter was directed against this contention.

I do not know how the integral expression for the energy is "generally" interpreted, but if it is interpreted with intelligence it will give perfectly accurate results. The system by which Prof. Comstock measures the electrostatic energy is a uniform distribution of "test points" throughout space. When the sphere expands the "region of integration" diminishes, since some of the points pass within the sphere; but the loss of energy, as calculated by the integral due to this cause, is balanced by the amount of work which the sphere does in passing over these points. If we do not neglect to consider this work, the ordinary integral gives the amount of electrostatic energy whether the distribution on the sphere is continuous or not.

NORMAN R. CAMPBELL.

Trinity College, Cambridge, February 24.

The Production of Prolonged Apnœa in Man.

IN NATURE of March 4 Mr. Royal-Dawson recalls a statement of Faraday to the effect that Mr. Brunel, jun., and a companion were able to stay under water about twice as long as usual if they had previously been breathing air at double the normal atmospheric pressure, and he inquires whether a similar relationship might not hold after forced breathing and oxygen inhalation, and so enable the maximum time of 8m. 13s. for which I could hold my breath under such conditions to be doubled. Increased pressure would, as a matter of fact, have scarcely any influence. As I pointed out in my letter of February 18, the essential conditions of prolonged apnœa are a previous removal of as much carbon dioxide as possible from the

body by forced breathing, and inhalation of oxygen just before holding the breath so as to prevent the system suffering from oxygen want. Neither of these two conditions would be influenced by doubling the atmospheric pressure, as a few deep breaths of nearly pure oxygen at normal pressure afford one much more oxygen than is needed by the body even during eight minutes.

If air is inhaled instead of oxygen, the duration of the apnœa is naturally increased with increase of the atmospheric pressure up to a certain point, as the total amount of oxygen thereby taken into the lungs, and rendered available for vital processes, rises proportionately to the pressure.

H. M. VERNON.

22 Norham Road, Oxford.

Moral Superiority among Birds.

TWO letters have recently appeared in NATURE upon this subject, but they have mainly referred to the relative moral sense of *different* groups of birds.

It may be of interest to note the relationships existing between *allied species*. Amongst Corvidæ, the rook is gregarious, and breeds in rookeries. It always allows the starling (Sturnidæ) and the jackdaw to associate with it, and even to breed in the midst of the same social community as itself. Thus these birds are regarded as on an equality, or at worst as inoffensive satellites. A feasible explanation is found in the fact that all three are social species, and frequent human habitations.

On the contrary, the carrion crow lives at most in pairs, never collecting in a body to feed or to nest. It is a scavenger, a feeder on offal, in a word, an outcast. Compared with the work of the rook or that of the two birds just mentioned, so beneficial to the farmer, the carrion crow's *rôle* is mean and degraded—though necessary. It is sly and cunning, and also addicted to purloining. Thus, compared with the rook, which is industrious and useful, and not usually sly, it exhibits a kind of moral inferiority. Very rarely does the rook suck the eggs of game or kill chicks, &c. (on which see *Shooting Times and British Sportsman*, July 18, 1908). Indeed, the moral inferiority of the carrion crow is proved by the rook's own attitude towards it. The latter will not allow the crow to invade its domains or to feed with it, and if any one of its own species turns to the evil habits of the crow it is ousted by general consent of the community.

The same demeanour is maintained in the relations between the rook and the magpie and jay.

Since psychic as well as morphic characters constitute the sum total of "specific" characters, the study of the moral sense in birds is important. In the animal world its very existence is perhaps best proved by experiment and comparison. Its neglect in biological work is a matter for regret. In the near future it must play an important part.

A. R. HORWOOD.

Leicester Corporation Museum, February 24.

The Dryness of Winter (1908-9).

THERE has been a good deal of surprised comment on the very dry character of this winter, but the season is apparently quite normal in this respect; that is, a very dry autumn tends to be followed by a dry winter. Here is a table showing the ten driest autumns at Greenwich from 1841 to 1907, and the rain-character of the winter following in each case:—

Ten driest Autumns		Rainfall inches	Rainfall Winters following inches	Relation to average (5·27)
(1)	1858	2·80	3·36	−1·91
(2)	1890	3·32	2·38	−2·89
(3)	1851	3·33	5·05	−0·22
(4)	1884	4·12	6·29	+1·02
(5)	1902	4·18	5·00	−0·27
(6)	1897	4·25	3·98	−1·29
(7)	1879	4·54	3·27	−2·00
(8)	1901	4·62	4·46	−0·81
(9)	1900	4·71	3·91	−1·36
(10)	1904	4·73	3·97	−1·30
Average		4·06	4·17	−1·10

Thus in only one case (1884-5) was the winter rainfall in excess.

The autumn rainfall of 1908 (3·94 inches) would come between (3) and (4) of the above list.

The opposite tendency (with a very wet autumn) is also, I think, perceptible, though less pronounced.

ALEX. B. MACDOWALL.

Is there a Vertical Magnetic Force in a Cyclone?

THE discovery of a powerful magnetic force along the axis of a solar vortex will have suggested, no doubt, to others besides myself the possibility of a vertical magnetic force in a terrestrial cyclone. If such should exist, and the electrification of the air be positive, there would be a reduction in the magnitude of the vertical component of the earth's field in the northern hemisphere when the centre of the cyclone passes over the place of observation. As to the magnitude of the effect, an elementary calculation shows that the intensity of the force in C.G.S. units at the centre of a mass of air 100 miles in radius, revolving with a velocity of fifty miles per hour at that radial distance, would be less than $10^{10}\rho$, where ρ is the volume density of electrification in coulombs per cubic cm. Under ordinary atmospheric conditions ρ has been estimated as of the order 10^{-19}, although much larger values have been sometimes obtained, and the magnetic force consequently would be of the order 10^{-9}.

Unless the density of electrification is very large in cyclones, it is not likely that a magnetic effect would be observed. Perhaps a tropical cyclone of great velocity, in an exceptionally highly charged atmosphere, might leave a small trace of its passage on the vertical force record.

Rochdale, March 8. J. R. ASHWORTH.

THE COAST OF THE CAUCASUS.[1]

M. MARTEL'S description of his journey and observations in the Caucasus forms one of those tall octavo volumes, handsomely printed and superabundantly illustrated, which are published in Paris at about one-third of the price that would be thought necessary in London. It is the outcome of a voyage for geographical study undertaken in 1903 at the request of M. A. S. Yermoloff, Minister of Agriculture to the Russian Government. The war in the Far East has hitherto delayed the publication of the results, which now takes place in this agreeable form rather than in an official pamphlet.

Among the towns that are rising on the eastern shore of the Black Sea, with a view to the attraction of visitors to a new and romantic Riviera, are Sotchi, the favourite of M. Yermoloff, and Gagri, the haunt of wealthy worldlings. Travellers in Russia will know how eager the rich are to get out of it in their weeks of leisure, and at Gagri since 1903 a pleasure station has been devised which may in time, within the limits of the empire, rival Biarritz or Monte Carlo. At present its richly oriental bazaar remains; in the fields behind the town the tombs of Mohammedan occupiers stand amid the lands they loved and tended; and even at the back of a sea-front of luxurious hotels there must always rise the castle wall built by Mithridates, the dark zone of forests, and the limestone plateau of Arabika, 8000 feet above the sea.

M. Martel's passage of the densely wooded ridges on the two flanks of the Arabika (pp. 172–87) supplied more adventure than is usual in a specially conducted tour, and this may have made him tolerant of civilised Gagri, then but a year old. But he is far more attracted towards Sotchi, farther up the coast (p. 90), where isolated villas are to rise on the margins of wooded parks, and where even the Grand

[1] "La Côte d'Azur Russe (Riviera du Caucase)." By E. A. Martel. Pp. 358. (Paris: Ch. Delagrave, n.d.—actually 1908). Price 10 francs.

Hôtel Pension has no licence for alcoholic liquors. "C'est l'équivalent," says M. Martel naïvely, "des *temperance-hotels* d'Irlande."

Near Sotchi, stratified gravels are noted, at times more than 25 metres above the shore, resting unconformably on the shales, and probably indicative of the former extension of the Black Sea in Pleistocene times. Behind the town, gorges extend up into the limestone hills, and here the conquered Tcherkesses may still be found. In a cavern of the Matsesta valley, the author, who cannot keep above the earth when there is a chance of descending into it, nearly lost his life from asphyxia in a hollow filled with sulphuretted hydrogen (p. 119). Only the prompt action of his friends restored him to the scientific world. But he writes of his experiences before fainting and during recovery with more interest in their medical aspect than in his own imminent danger. Rags are hung by the natives at the entrance to the mineral springs, just as at holy wells in Ireland; as the author points out, the cult of medicinal waters probably goes back to prehistoric times.

Travelling in these valleys must at present be done on horseback up the waterways—that is, largely in the streams themselves. Camping out in terrific rains, sometimes lasting forty-eight hours, seems an ordinary affair in September. On the other hand, June and July are not good months for this Riviera. The fine days and the exquisitely varied landscapes seem, however, to atone for everything, and M. Martel gives a special chapter on malaria, so prevalent in the low coastlands, in which he states that he felt touches of fever when coming below an altitude of 200 metres. Yet he experienced no bites from insects, and malaria does not seem to be serious in August, September, and October. He is evidently of opinion that a better water supply, on lines recommended by him for various places, and a higher standard of living, may fortify the coast-dwellers against a disease primarily due to the mosquitoes (p. 334). A fine new road already leads up from Sotchi to Krasnaïa-Poliana for those who would prefer the mountains, and the Alpine climber may use this village as a centre after passing through a noble limestone gorge.

In chapter xiv. we reach the Caucasus itself, and the author's photographs of snowy ranges are worthy of his fine views in the forests. He illustrates antiquities with equal interest, as his castle of Tiflis (p. 243) and the pictures from Ani (p. 289, &c.) show. Ani, a superb creation of Armenian kings in the tenth century, is now within an hour or two of a railway station on the way from Tiflis to Erivan. Ararat rises snow-clad from a great plain on the south, and the plateau on which Ani is built is formed of tuffs and basaltic lavas. M. Martel found in this ruined city, with its churches and mosques, its walls and towers, a combination of Carcassonne, Aigues-Mortes, Pompeii, the Acropolis of Athens, and a good deal else, while the desolate surroundings recalled to him the solitude of the Causses. How many of us know that there is a miniature Ani, also walled and towered, in the Causses, which has survived almost as many centuries—La Couvertoirade, a hospice for those who, like the Armenians, fought against the Moslems in the east?

View of Ararat. From "La Côte d'Azur Russe."

The author brings his geological notes together in chapter xxiv.; but the value of his work lies mainly in the breaking of new ground, on which others will be glad to build. The book should be judged, indeed, as a contribution to social geography, showing how the arts of peace are now bent, under Russian rule, on the completion of the conquest of the Caucasus. It is worthy of a far better map, and surely also of an index.

GRENVILLE A. J. COLE.

THE METEORIC STREAK OF FEBRUARY 22.

REPORTS continue to come in descriptive of this remarkable appearance. It was distinctly visible to 9h. 30m., though it had become faint and diffused, and could still be feebly glimpsed at 10h. The length, as given by a few observers, was

	h. m.	°
Bournemouth	7 35 ...	45
Guernsey	7 45 ...	65
Bruton, Som.	7 45 ...	60
Petersfield	7 55 ...	105
Bournemouth	8 0 ...	110
Hereford	8 0 ...	80
Purley, Surrey	8 12 ...	100
Lyme Regis	8 15 ...	110
Petersfield	8 25 ...	120
Weston-Super-Mare	8 30 ...	85
Petersfield	8 55 ...	45

At Bournemouth, 8h. 25m., the whole length, including the bends, "was well over 180°."

The middle portions of the streak apparently moved with greater celerity than the other parts. The drift was decidedly to N.W., and this nearly conformed with the direction of the wind, which was from the E. or S.E. quarter. The rate of motion of the streak is difficult to ascertain exactly, for there is no doubt that its various sections varied in height between about fifty-five and twenty-five miles, and were affected in different degree by wind currents. A mean of the displacement observed in a number of cases gives seventy-five miles per hour as the rate of velocity, while a few of the best drawings would indicate a rather greater speed of eighty or ninety miles per hour.

The delineations and descriptions of observers are very discordant in some cases, and will not admit either of satisfactory comparison or explanation. It is a pity that photographs could not have been secured, but the rapid motion of the streak and its increasing faintness prevented this being accomplished, though the attempt was made at some places.

Several observers noted flashes like very faint lightning during the early period of the projection of the streak. Others allude to the fact that it exhibited bright pulsations, as though the lingering embers were fanned into brilliancy by the breeze. A few of the most careful spectators state that they noticed scintillations of the beam similar to the temporary light-waves which affect the streamers of Auroræ.

At the end of its westerly career the meteor appears to have met some dense air strata, which effectually barred further progress and directed it earthwards. No doubt the force of its initial velocity must have been nearly spent by its long and nearly horizontal flight through the atmosphere.

The meteor was directed from an apparent radiant near β Leonis, situated so far from the Apex of the earth's way that we should not expect the shower to provide meteors with streaks. Ordinarily, it is only the swifter class of objects, such as Leonids, Perseids, and Orionids, which evolve phosphorescent after-glows, and which are so helpful to observers in recording their flights accurately. The slower meteors, such as February Leonids, usually leave trains of yellow or red sparks of momentary duration, and this was a feature of the meteor of February 22, but it also supplied the long-enduring streak which formed its most striking characteristic. In fact, many more observers were attracted by the streak than by the meteor, for comparatively few noticed the latter. This, however, is accounted for by the short duration of the actual flight of the nucleus (about seven seconds) as compared with the persistency of the after-glow.

The meteor had a long way still to travel before it could have reached the earth had it continued its course westwards. Could it have withstood disruption and dispersion, it would have fallen into the sea about forty miles south of the Scilly Isles, and this is about 120 miles E. of the point where it appears to have collapsed, and its material to have been deflected southwards. W. F. DENNING.

SECONDARY EDUCATION IN ENGLAND.

A DEPUTATION of the Parliamentary Committee of the Trade Union Congress waited upon Mr. Runciman, President of the Board of Education, last week to bring forward a resolution passed at the Nottingham Congress, stating that no solution of the educational problem would be satisfactory that did not give free education from the elementary school to the university, and demanding the immediate abolition of fees in secondary schools and training colleges. It was urged by members of the deputation that the fees at secondary schools were becoming too high for working people to pay, and that in some cases the rule as to the reservation of 25 per cent. free places for pupils from public elementary schools is not observed. In his reply, Mr. Runciman expressed himself in sympathy with the deputation, but was able to show that above half the State-aided secondary schools provided in 1907–8 more than the stipulated 25 per cent. of free places, and the great majority of the whole provided the 25 per cent. He also pointed out that every child is not suitable to enter a secondary school, and that it is necessary to have a fairly good standard of examination for the children who wish to enter.

As the views put forward by the deputation may give rise to misconceptions, and as the position and nature of secondary education in England are not widely understood, it seems desirable to bring together a few facts relating to them.

By the Board of Education's regulations for secondary schools, a uniform grant of 5*l.* is made by the State annually for every pupil between twelve and eighteen years of age, provided that the pupil is not evidently unfit to profit by the education given. The condition under which this grant is made is that 25 per cent. of the places in the school must be offered free to pupils who have for two years immediately preceding been in attendance at public elementary schools. An entrance examination is conducted by the governing body of the secondary school, but it must be qualifying and not competitive, unless the number of applicants is greater than the number of free places. The aim of the Board is "to provide State-aided secondary education in the degree to which, and at the points at which, it is really needed; and to ensure free access to it for children of every class according as the individual is intellectually capable of receiving profit from it."

With these aims most people will find themselves in agreement, and the regulations of the Board show how the desired object may be attained. There are now about 700 secondary schools in which pupils from public elementary schools can claim free places. Grammar schools have sold their birthright for the mess of pottage represented by the capitation grant of 5*l.*; and their doors are now open freely to a number of pupils from primary schools equal to one-quarter of the accommodation available. The result is that, of the 105,000 children attending State-aided secondary schools in 1907, just over 54 per cent. had previously attended public

elementary schools, and of these pupils about 45 per cent. were paying no fees at the secondary schools. That is to say, nearly one-half the number of pupils drafted from public elementary schools to secondary schools receive their education in these schools free.

The 25 per cent. of free places in secondary schools, and the liberal distribution of scholarships by local authorities, has, in fact, placed secondary education within the reach of capable children in most districts. The provision of secondary schools in some districts may be inadequate, but a fair part of the school places are filled by children from elementary schools paying low fees or none at all. Indeed, it is scarcely too much to say that secondary education is now practically free to all elementary school children who can derive advantage from it, and whose parents are prepared to let them accept it. If secondary education were made completely free to-morrow, the demand for places in secondary schools by children capable of entering such schools would probably not greatly exceed that at present. As a rule, working-class parents let their children leave school either at the minimum age or a year or so later. There are so many ways in which children from fourteen to eighteen years of age can earn comparatively high wages in unskilled employments that the temptation to their parents to make them immediate wage-earners is very strong. To induce such parents to keep their children at school it is not sufficient, therefore, to make secondary education free; they have to be paid to let their children take advantage of it.

Though the deputation to Mr. Runciman did not ask for maintenance grants for children at secondary schools as compensation for the loss of the immediate fruits of the children's labour, this demand was included in a resolution adopted at the Trade Union Congress at Bath in 1907. It was then resolved, *inter alia*, "That secondary and technical education be an essential part of every child's education, and secured by such an extension of the scholarship system as will place a maintenance scholarship within the reach of every child, and thus make it possible for all children to be full-time day pupils up to the age of sixteen."

It is evident, then, that free education will not satisfy the demands of the organised workers of the country; there must also be maintenance scholarships for all children. Surely a more reasonable demand would be for secondary education to every child who is capable of benefiting by it, and maintenance grants for really poor children of exceptional aptitude. In some places there are more scholarships than children of a sufficient standard of attainment to justify their award. By an examination of scholarship statistics, Prof. Sadler found that in 1906 nearly 12,000 scholarships and bursaries were awarded by local education authorities to enable children to pass from primary to secondary schools, so that, assuming that on an average these scholarships were tenable for three years, this gives a total of 36,000 scholarships running concurrently, in addition to about 10,000 scholarships and bursaries confined to intending pupil teachers. The total amount spent annually by local education authorities on these junior and pupil teacher scholarships is apparently rather more than half a million. Nearly half the total number of scholarships awarded, however, were of the nominal value of 3*l*. or less, so, although they provided free secondary education, they could not be considered as grants for the maintenance of the scholars while at school.

The county scholarships of the London County Council provide a complete scheme under which a boy or girl may proceed by various stages from the public elementary school to the highest grades of education, whether at a university, technical college, or other institution, providing advanced training for a professional career. The junior county scholarships (ages of candidates, eleven to twelve) are awarded to all candidates — about 2000 — who reach scholarship standard; and they provide free education at public secondary schools approved by the Council and a maintenance grant of 6*l*. a year. The intermediate county scholarships, not less than one hundred of which are awarded annually, are open to candidates of ages fifteen to seventeen, give free education at approved secondary schools or technical colleges up to a fee of 25*l*. a year and a maintenance grant of 25*l*. or 30*l*. a year. The senior county scholarships (ages nineteen to twenty-two years), fifty of which are awarded each year, provide a maintenance grant of 60*l*. a year for three years, and tuition and examination fees up to 30*l*. a year. All the scholarships are confined to candidates whose parents have incomes not exceeding 160*l*. a year in the case of the junior scholarships and 400*l*. a year in those of the intermediate and senior scholarships.

The weak point of the scholarship system in general is the disproportion between the numbers of junior scholarships and of those demanding exceptional ability. The scholarship net ought to have a wide mesh, so that only large fish are caught, whereas the reverse is often the case. Prof. Sadler's inquiry showed that the number of intermediate scholarships is only 4 per cent., and of senior scholarships only 3 per cent., of the number of junior scholarships. The result is that a large number of children of average powers are given an education unsuitable to their needs, instead of expending the money upon a few carefully selected individuals of unusual capacity.

Scholarships and free places facilitate the passage from the primary to the secondary school, but statistics show that four-fifths of the pupils who enter such schools leave without completing their course, presumably to enter some trade or industry. A summary of figures relating to State-aided secondary schools in England was published by the Board of Education in 1907. The number of schools dealt with was 600, and the total number of pupils, excluding pupil teachers, was 105,000. About 80 per cent. of this number of pupils were fifteen years of age or under, and the remaining 20 per cent. represented the number of pupils above fifteen years of age in State-aided secondary schools. The same rate of educational leakage is indicated by recent statistics prepared for the London County Council Education Committee to show the ages of pupils attending London secondary schools which receive financial aid from the Council. The number of these schools is fifty, and there are in attendance 9917 boys and 6132 girls. The following table deserves study :—

Age		Boys		Girls
Under	10 years ...	504	...	552
Between	10 and 11 ...	517	...	716
,,	11 ,, 12 ...	1313	...	812
,,	12 ,, 13 ...	1634	...	903
,,	13 ,, 14 ...	2010	...	1131
,,	14 ,, 15 ...	1863	...	1055
,,	15 ,, 16 ...	1135	...	683
,,	16 ,, 17 ...	576	...	409
,,	17 ,, 18 ...	261	...	233
Over	18 years ...	104	...	68
		9917		6162

The table serves, among other things, to show that even in London the majority of parents who send their children to the county schools regard fifteen as the age at which secondary education should stop, and that comparatively few appear to be able to allow their

children to remain at school after sixteen years of age. These facts apply both in the case of boys and girls. The net result is, therefore, whether we consider England as a whole or London in particular, only about one-fifth of the pupils in secondary schools receiving annual grants of 5*l*. per pupil from the State, and supported largely by local rates, are more than fifteen years of age. Our State-aided secondary schools are, in fact, mostly of the nature of higher elementary schools which pupils leave before they are sixteen, instead of being true secondary schools in which students remain until they are eighteen or nineteen years of age. When the majority of pupils remain until this age, the higher work which should be the distinguishing characteristic of secondary education will be possible, but at present it is an euphemism to describe as secondary schools the numerous institutions which merely put a finishing touch upon primary education. Judged by German standards and the ages of the pupils, our secondary schools receiving State grants would for the most part be more correctly described as day continuation schools.

It may be presumed that pupils who leave school at fifteen or sixteen years of age do so in order to begin industrial or commercial careers. The school course of such pupils should obviously differ from that of students who propose to continue their education to a later stage, with the view of entering universities or professional life. Schools which only keep their pupils until sixteen years of age or under ought, therefore, to have a curriculum appropriate to the needs of pupils who will enter offices or workshops immediately they leave. To make such pupils commence a course which has a university examination as its ultimate end is to waste time and opportunity. Only in schools where most of the students remain until they are eighteen or nineteen years of age should a curriculum tending to the requirements of professional careers or universities be adopted.

The necessity for the provision of different types of school for the education of boys and girls above fourteen years of age was urged last year by the Association of Teachers in Technical Institutions, and recommended in the report of the education committee of the British Science Guild, printed in NATURE of January 28. Two types of secondary school should be recognised—one in which pupils leave at about sixteen years of age to enter industrial or commercial life, and the other in which pupils remain to eighteen or nineteen years of age and leave to enter the universities, the professions, or technical institutions of university standard. The former type of school, described variously as a "trade," "preparatory trade," or "craft" school, should prepare definitely for trades, crafts, industries, or commerce. In the words of the British Science Guild report:—"Due regard should be paid in these schools to the continuance of the general education of the pupils, but special provision should be made for sound scientific and technical training in relation to the industries or requirements of the district." The true secondary school may aim at a higher standard on the purely academic side; and its curriculum should be of an entirely different character from that of the craft school. Up to the age of thirteen or fourteen there is really no sound educational reason against the adoption of a single curriculum for all boys and girls—whether in public elementary schools or in preparatory schools. From that point, however, the pupils who do not leave school should be able to continue their education in different schools, according to their needs. To use a metaphor, the train which a pupil will enter at the age of fourteen will differ according to his destination.

In addition to the secondary schools referred to in the foregoing statement, and regarded as efficient by the Board of Education, about thirty technical institutions are recognised by the Board as giving an organised course of instruction in day classes, including advanced instruction in science or in science and art. These schools are attended by about 2700 students, mostly above seventeen years of age, of whom rather more than half attend a full course of instruction. The number of students in evening schools and classes carried on for the education of persons already engaged in some occupation which takes up the greater part of their time is about 700,000. In the case of most of these students, their sole educational training has been in the primary school up to the age of thirteen or fourteen years. At about sixteen years of age or later, they enter the technical schools, after a period of three or four years in which they have received no systematic instruction. The result is that a large part of the work now done in evening classes in technical schools is of a very elementary character. The teachers are capable of giving higher instruction, but the want of the most elementary knowledge on the part of the students will not permit them to do so.

As was stated last year by Prof. W. M. Gardner in a discussion at the annual general meeting of the Association of Technical Institutions, that of a hundred boys passing through elementary schools, and ultimately taking positions as industrial workmen, foremen or managers, probably not more than four or five pass through a secondary school, and not more than three or four attend a day technical school. The great problem is, therefore, that of the boys who leave the primary schools at the ages of thirteen or fourteen, or even earlier, and constitute ninety-five out of every hundred boys of that age. Three courses seem to be open:—(1) to provide for practical instruction to occupy a large part of the time during the latter years of a primary-school course; (2) to pass boys forward from the primary school to specially arranged trade or craft schools for one or two years; or (3) to depend, as hitherto, upon evening schools for technical instruction. The provision of craft schools seems to offer the best solution of the problem. Where the leaving age is low—as it is in most of the State-aided secondary schools—the Board of Education should urge that the schools be of a commercial or industrial type in which practical work, having a direct bearing upon the needs of the district, will occupy at least half the time of the course. The leaving age should determine the scope of the curriculum, and the interests of the district should decide the technical tendency to be given to the practical work in the schools which pupils leave at about fifteen years of age.

As to secondary schools of a high educational type, consideration of the facts available leads to the conclusion that there will have to be many more pupils in schools of this character if the position of secondary education in England is to be comparable with that in Germany. From a national point of view, much of the money expended to secure free places at secondary schools for pupils from public elementary schools is wasted, for the work at the schools leads usually to distaste for an industrial career, and ends in boys taking up some clerical occupation. The only secondary education which will assist the industrial progress of the country is that which results in an increase in the number of highly-trained men to become captains of industry. Any money expended

by the State in providing educational facilities for these leaders of men is a profitable investment.

At present, the Government grant to meet expenditure in respect of elementary education is about 11,500,000*l.* annually; and the sum paid in grants for pupils in secondary schools in England and Wales taking an approved course between the ages of twelve and sixteen years is about 340,000*l.* In addition, local authorities expend about 3,400,000*l.* a year on education other than elementary. Of this amount, about 700,000*l.* is expended on secondary schools, 1,200,000*l.* on evening schools and institutions for higher and technical education, and 260,000*l.* upon day schools of similar scope. The State-aid and rate-aid to the seven hundred secondary schools, now accommodating about 113,000 pupils in England and Wales, amounts, therefore, to rather more than one million pounds annually.

This is a modest sum compared with expenditure upon other objects, but little increase can be justified for secondary schools until the demand for secondary education is greater and more real than at present. Free education from the primary school to the university may be within the realm of practical politics, but unless it is accompanied by maintenance grants equivalent to the wage-earning capacities of poor students it will not satisfy the demands of the Trade Unionists. Whether it is desirable to offer this inducement to continued study to all children may be doubted; the nation should be concerned only in providing adequate opportunities for the development of children whose life-work is likely to promote national welfare. The way should be open from the primary school to the university, but a passport should be demanded at each gate to show that the student is capable of making the best use of the new fields to which he is admitted. By this system, and a judicious extension of the number of intermediate and senior scholarships to provide for maintenance, any student of distinguished ability would be able to command the highest educational training this country can offer. R. A. G.

RADIUM INSTITUTES.

THE March number of the *Deutsche Revue*[1] is to contain the announcement by Prof. P. Lenard, director of the Physikalische Institut of the University of Heidelberg, that a radium institute, of the kind already in process of formation in Vienna, London, and Berlin, is to be opened for work in Heidelberg in the Easter of the present year. Owing to the foresight and cooperation of the Senate of the University and the Ministry of the Grand Duchy of Baden, an endowment has been secured, and the Heidelberg Institute will thus be the first of its kind actually to come into existence and to commence work. It is to be known as the Radiologische Institut. The term *Radiology*, which we might also with advantage accept, is used in Germany to connote the newer branches of physics concerned with the study of the invisible radiations, particularly, of course, the kathode, Lenard, Röntgen, and Becquerel rays, but comprising also the older known invisible ultra-violet and infra-red light radiations, their methods of production, their relations to matter, including radio-activity, phosphoresence, and photo-electric action, and their practical applications, for example, in medicine.

Prof. Lenard prefaces his announcement with the remark that the new field of investigation has already proved itself of such fruitfulness that it is quite impossible at the present time to delimit its true circumference. Every day arise new problems, for example, in such fundamental subjects as the constitution of matter, now assailable with hope of success. The cultivation of this field demands special fostering, not only on account of its immediate fruitfulness, but also on account of the costliness of its prosecution—if only in the provision of those rare materials, like radium, which it has brought into recognition—and on account of the necessity for close cooperation between the scientific workers and those engaged in the practical applications of the new knowledge.

The new institute at Heidelberg is to undertake this work. It is to be under the same direction as the Physikalische Institut of the University, and will thus secure full benefit from the whole existing resources of the institute. Provisionally 300 square metres area in the Frederichsbau will be set aside for it. Later it will be housed in a special wing of the new buildings of the Physical Institute. The endowment will ensure the furnishing of the institute with the best equipment that can be secured, while the spring sediments from the neighbouring State of Kreuznach, to be worked up by the Government salt department, will provide a source of radio-active material for clinical and scientific investigation. The institute will provide special instruction in the subjects it deals with, while the clinical work will be undertaken by Herren Czerny and Krehl in their own buildings, but with close cooperation with the Physical Institute, which will ensure that the work rests upon a thoroughly sound scientific basis.

[1] Published by Richard Fleischer, of the Deutsche Verlags Anstalt.

The constitution and work of the Radium Institute to be established in London are described in an official statement published in the *British Medical Journal* of March 6. From this statement we learn that the King has consented to become the patron of the institute. A site has been acquired in Riding House Street, Portland Place, upon which the necessary building will be erected with as little delay as possible. In general terms, it may be said that the institute will be conducted upon the lines of the Radium Institute in Paris. In addition to the superintendent, the assistant to the superintendent, and the director of the laboratory, there will be an honorary medical and surgical staff (not yet appointed). The institute hopes to acquire radium to the amount of 5 grams.

The treatment carried out in the institute will be strictly limited to treatment by radium or other radio-active substances. Treatment of cases by the Röntgen rays, the Finsen light, and by electrical currents will have no place in the institute, as such measures of treatment are already very amply provided for elsewhere.

The building will be in two parts, with separate entrances. One section will be devoted to necessitous patients, and the other to the well-to-do. The former will be treated free; the latter will be required to pay fees on such a scale as the medical and surgical staff may determine. No patient, poor or well-to-do, will be treated in the institute except upon the imprimatur of a qualified medical man.

Demonstrations in the use of radium will be given, and medical practitioners can be advised as to the mode of employment and as to the radio-activity of their own specimens of radium.

THE SUMMER SEASON TIME BILL.

THE debate upon the Summer Season Time Bill, commonly known as the Daylight Saving Bill, in the House of Commons on Friday last, was, for the most part, a pitiful exhibition of the incompetence of politicians to understand any question involving a knowledge of elementary science. Though the proposals in the Bill would dislocate the entire machinery of time-reckoning, less than forty members were present at the opening of the discussion; and

the House was only saved from being counted out on two occasions by sufficient members rushing in to form a quorum. The substance of the Bill was given in last week's NATURE. Briefly, it is proposed that at 2 a.m. on the third Sunday in April of each year, all clocks shall be put forward one hour, and shall remain in advance of Greenwich mean time and Dublin mean time by this amount until 2 a.m. on the third Sunday in September, when the hands are to be put back again.

We do not propose to repeat now the substantial arguments against this proposal stated in these columns on July 9, 1908, but we do suggest that the article could be read with profit by the members who voted for the second reading of the Bill, which was for the second time referred to a Select Committee of the House of Commons. During the debate many illustrations were used to convey to the minds of the members some idea of the relation between local time and mean time, and of daylight to business hours. No one pointed out, however, that it would be more reasonable to change the readings of a thermometer at a particular season than to alter the time shown by the clock, which is another scientific instrument. Perhaps it is contemplated to bring in a Bill to increase the readings of thermometers by ten degrees during the winter months, so that 32° F. shall be 42° F. One temperature can be called another just as easily as 2 a.m. can be expressed as 3 a.m.; but the change of name in neither case causes a change of condition.

The argument that inconvenience is not felt by travellers on the Continent changing their watches to mid-European and east-European time, or by the five standard times of America, has little bearing upon the question. The inhabitants of any of these regions use a particular standard time, as we use Greenwich time, but their hours of work and leisure are determined by national custom. The most noteworthy characteristic of life in France and Germany is the earlier hours at which places of business open in the summer compared with those usual in our cities. In Germany many schools open at 7 a.m., and the usual hour is 8 a.m. The people adapt themselves, therefore, to the daylight hours instead of pretending to do so by putting on the clocks by one hour in April and back an hour in September. In all places between the same latitudes as those of the British Isles, the relation of daylight to the time of the standard meridian is the same, so that whatever arguments can be advanced in favour of the proposed seasonal change of time in our country, beyond those of custom, would apply equally to the inhabited zone between fifty and sixty degrees completely round the world.

It is only in a few great cities in England that the waste of daylight described by the supporters of the Bill really exists; and even in these places it is possible for people to rise an hour earlier for work or recreation if they desire to do so. Industries and occupations which can best be carried on in daylight make the fullest use of daylight hours at present, without any legislative compulsion. Agricultural operations begin shortly after sunrise during a large part of the year, and continue until nearly sunset; in the building trades the hours of work vary with the hours of daylight, and the same is true in most engineering shops. But when work or pleasure can be carried on equally well in artificial light, there is a tendency to continue it to the limits of endurance. So it has come about that the bedtime hour in cities has been pushed further and further into the night, and the hour of rising has become later.

All that is needed is for banks, places of business, and schools to open at an earlier hour during the summer months, as they do in most places on the Continent. To introduce confusion into the whole system of time-reckoning because some people in cities have not sufficient strength of mind to make the best use of the daylight hours would be to acknowledge that, as we cannot alter our national habits and customs, Acts are passed by which we pretend to change them while they remain the same.

PROF. JULIUS THOMSEN.

THE two great enrichers of thermal chemistry were Berthelot and Thomsen. Berthelot died in the spring of 1907, at the age of eighty; Thomsen has just left us, at the age of eighty-three. Born at Copenhagen in February, 1826, and educated in the polytechnic there, Thomsen became professor of chemistry in the university of his native city in 1866; he retired from the duties of his post in 1901, but continued to live and work in Copenhagen.

Julius Thomsen devoted his life to the experimental advancement of thermal chemistry. His first memoir on this subject was published in 1853, his last a few years before his death.

The permanent memorial of Thomsen's work is the four volumes of "Thermochemische Untersuchungen," published in the years 1882–86. In the year 1780 Lavoisier and Laplace announced that "all thermal changes . . . exhibited by a system of bodies which changes its state repeat themselves in the opposite direction when the system returns to its original condition." This generalisation was deduced from a theory of heat, and was to some extent verified by experiments. In the years 1839–42 Hess laid the foundations of thermal chemistry, sketched the lines on which the structure should be built, and began the building. Thomsen began his work soon after the appearance of Hess's memoirs. He has formed a stately building—adorned perhaps with too many crockets and pinnacles—resting on the sure foundation of experimentally established facts.

In the preface to his great work, "Thermochemische Untersuchungen," Thomsen tells us that he formed the plan of the whole before he began his experiments, and that he adhered almost rigorously to that plan. When the work was nearly completed, he recognised that the science of thermal chemistry would be benefited by collecting and digesting his materials, and so he published his investigations and his theoretical discussions thereof in the four volumes which have established his fame. In 1905 Thomsen published a *résumé* of his principal experimental results and discussions in one volume. Unfortunately, that book was written in Danish; fortunately for English workers in the field of thermal chemistry, an English translation of it has appeared in Longmans' series of text-books of physical chemistry, edited by Sir William Ramsay.

Thomsen set out with a determination to extend his thermal investigations over the whole field of chemistry. He carried that determination into effect. The first volume of the "Untersuchungen" deals with the thermochemical aspects of the neutralisation of acids and bases. The second volume is devoted to the reactions, and the classification of the affinity-phenomena of the non-metallic elements. The third volume is concerned with measurements of the heats of dissolution in water, with hydration, and with the affinity-phenomena of the metals. The thermochemical investigation of carbon compounds is the subject of the fourth volume.

The most important results of Thomsen's examination of neutralisation were the firm establishment of

the constancy of the heat of neutralisation of strong acids by strong bases, the introduction of the conception of the *avidity* of acids and bases, and the working out of a thermal method of measuring avidity. In his investigation of solution and hydration, Thomsen paved the way for future work, cleared away many misconceptions, and put the thermal aspects of the questions on a secure basis. It is not yet time to interpret the thermal data concerning the classification of elements wherewith Thomsen has enriched chemistry; but the data are there, established by a most careful and ingenious experimenter. In speaking of Thomsen's work on the thermochemistry of carbon compounds, one has to distinguish between the data and the theoretical discussion of them. The data are sure. Personally, I think his theoretical conclusions are inadmissible.

The tremendous question of chemical affinity was attacked, thermochemically, by Thomsen with boldness. So long ago as 1854 he announced his much-discussed generalisation:—"Every simple or complex action of a purely chemical character is accompanied by production of heat." In 1882 he was not quite so sure, and modified his dictum, asserting that "the great multitude of chemical processes which are accomplished without the aid of foreign energy, and are free from by-reactions, are accompanied by production of heat." This form of the law of maximum work is surely a sound generalisation, but it is purely empirical. Thomsen never thoroughly analysed the concept *chemical affinity*. Affinity is only one factor of chemical energy, as quantity of heat is only one factor of thermal energy. Thomsen's great contribution to the subject of chemical affinity is the mass of his well-established thermochemical data.

It seems to me that the two marks of Thomsen's experimental work are its soundness and its orderliness. There is nothing haphazard, nothing slipshod about it. He worked on a definite plan; he worked with all his might; his work must remain to his everlasting honour. M. M. PATTISON MUIR.

NOTES.

THE attention of all who are interested in the work of zoological exploration is directed to the expedition which is now being organised by Mr. W. R. Ogilvie-Grant to explore the Charles Louis Mountains of Dutch New Guinea, which form the highest part of the range extending right across the island from east to west. The highest peaks have an altitude of some 17,000 feet. A rich harvest is expected, for until recently the hostility of the natives has frustrated all attempts on the part of European travellers to enter this territory. This hostility, however, has now been overcome, and no effort should be spared by the naturalists of this country to be the first in the field to tap what will certainly prove to be one of the richest zoological regions in the world. Mr. Grant is endeavouring to secure ample funds in order that both the zoology and botany of this region may be thoroughly investigated. If this is to be done, a sum of at least 3000*l*. will be necessary. A considerable portion of this sum has already been generously provided, but more is yet required, and it is hoped that this will speedily be forthcoming. Those who desire to help should send subscriptions to Mr. C. E. Fagan, British Museum (Natural History), Cromwell Road, S.W. The leadership of the expedition has been entrusted to Mr. Walter Goodfellow, who has already done much valuable work in the exploration of New Guinea. To make the more certain of success he will be accompanied by Mr. W. Stalker and Mr. A. F. R. Wollaston, both of whom have done good work in New Guinea, as well as in other parts of the world.

THE executive committee of the British Empire League is organising a movement to provide London with a monument to Captain Cook. Cook was a man of science as well as an explorer; his hydrographical surveys are excellent examples of the scientific work of our navy, and he contributed also to astronomical and medical science. Last November the British Empire League appointed a sub-committee to promote the object and to form a general committee. We have received a list of the names of distinguished persons who have consented to join the general committee, and these include representatives of Australasia, the Colonial Office, the Admiralty, the scientific societies, the shipping industry, and the Cleveland district of Yorkshire—of which Cook was a native. The general committee will later appoint an executive to collect the necessary funds, to determine the character of the memorial, and to select the best available site. It is estimated that, if the monument be in the form of a statue, 3000*l*. will be needed. Fuller particulars can be obtained from the secretary to the British Empire League, Mr. C. Freeman Murray, Norfolk House, Laurence Pountney Hill, E.C.

ON Monday evening Dr. M. A. Stein read before the Royal Geographical Society a paper on his geographical and archæological explorations in Chinese Turkestan in 1906–8. We have from time to time noticed Dr. Stein's discoveries while his expedition was in progress. His lecture on Monday evening strengthened opinion as to the importance of his researches, and brought out very clearly the widespread influence exercised by Indian and classical art on Buddhistic temple worship throughout Central Asia during the early centuries of the Christian era. Dr. Stein told the story of one important discovery about which until now he has kept a discreet silence. He was greatly desirous of examining a secret store of ancient manuscripts which had been accidentally discovered by a Taoist priest in the Caves of the Thousand Buddhas, south-east of Tun-huang. The priest knew nothing about the character and importance of the treasures he was guarding, but it was only after prolonged discussion that he consented to produce some of the manuscripts for Dr. Stein's inspection. These happened to be fine rolls of paper containing Chinese versions of certain Buddhist texts, which the colophons declared to have been brought from India and translated by Hsüan-tsang, the famous Chinese pilgrim, whom Dr. Stein is wont to call his patron saint. Much impressed by what he regarded as a special interposition by Hsüan-tsang on Dr. Stein's behalf, the priest was induced to show the explorer the secret chamber containing his treasures. These were piled up without any sort of order to a height of 10 feet, and comprised not only written documents, but fine paintings on silk and cotton, ex-votos in all kinds of silk and brocade, and streamers in various fabrics. Dated documents showed that the chamber must have been walled up about 1000 A.D., but some of the records dated back so far as the third century A.D. After prolonged negotiations, Dr. Stein was permitted to make a selection from the documentary and other remains, and filled with them twenty-nine cases, which have now been deposited in London. We hope to return to the subject of Dr. Stein's discoveries at greater length on the publication of his paper.

THE death is announced of Senhor J. Barbosa Rodrigues, director of the botanical garden at Rio de Janeiro, and author of several works on Brazilian flora.

THE guarantee fund for the International Aëronautical Exhibition, to be opened at Frankfurt a. M. in July, amounts to 700,000 marks. Count Zeppelin has contributed 10,000 marks to the fund. It is expected that a sum of one million marks will be raised.

INVITATIONS have been issued by the president of the Royal Society, chairman of the general board of the National Physical Laboratory, to meet the general board at the laboratory, Bushy House, Teddington, on Friday, March 19, when the various departments will be open for inspection, and apparatus will be on view.

THE thirty-sixth annual dinner of the old students of the Royal School of Mines will be held on Tuesday, March 30, at the Hotel Cecil. The chair will be taken by Mr. F. W. Rudler. Applications for tickets should be made to Mr. George T. Holloway, hon. sec. dinner committee, 57 Chancery Lane, W.C.

IN the third biennial report of the commissioners of the Connecticut Geological and Natural History Survey, for 1907–8, attention is specially directed to the scientific interest and economic importance of the peat-deposits of that State. At the melting of the great ice-sheet the surface of Connecticut was dotted over with innumerable lakes and pools, many of which have since become obliterated, some by the growth of peat and some by other causes. Most of these peat-bogs have now been carefully surveyed and sounded, so that the amount of their cubic contents can be approximately ascertained. Peat is used in the State not only for fuel and as a gas-producer (for which it is specially suitable), but likewise as a fertiliser, and, incidentally, for various other purposes.

SINCE the importance of "types" to the working systematic naturalist can scarcely be overrated, the authorities of the U.S. National Museum have set a good example to museum curators generally by issuing a catalogue of all the mammalian specimens of this nature preserved in the institution under their charge. This catalogue, which is published at Washington as Bulletin No. 62 of the museum, has been drawn up by Messrs. L. M. Ward and W. H. Osgood, who appear to have discharged a by no means easy task in a thoroughly satisfactory manner. The number of mammalian species of which the museum possesses the types is very large, but it should be borne in mind that, in addition to real types, the list also includes "cotypes," "lectotypes," &c. So far as practicable, all the type-specimens in the collection have been arranged in special cabinets, a plan which may be commended to the best attention of those in charge of other museums.

THE skull and brain of the horned dinosaurs, Triceratops, with notes on the brain-cases of Iguanodon and Megalosaurus, form the subject of a paper by Dr. O. P. Hay, published as No. 1660 of the Proceedings of the U.S. National Museum (vol. xxxvi., pp. 95–108). Several specimens of the brain-case of the Ceratopsia are available for study, from which casts of the brain itself have been taken, but great difficulty has been experienced in homologising the different parts owing to the fact that the bones of this region of the skull are more or less completely welded together. This has led, in the author's opinion, to several misidentifications, notably in the case of the supra-occipital. The paper is, however, of an extremely technical nature, and without explanatory figures it would be little use discussing the author's emendations and conclusions. Certain amendments are suggested on previous determinations of the component elements of the brain-case in the iguanodon and the megalosaur.

FROM the study of its crinoid fauna, Mr. A. H. Clark in an earlier paper suggested, with some hesitation, that the entire Australian coast, southern as well as northern, should be included in his "Indo-Pacific-Japanese" region. The determination was based on the fact that all the Australian crinoids are tropical forms, the element of hesitation being due to the apparent absence of the South Australian genus Ptilometra from the rest of the region. In a paper on crinoids from the Philippines, published in vol. lii. of the Smithsonian Miscellaneous Collections, the author announces the discovery of the genus in question to the north of the equator, thereby definitely determining the correctness of his earlier suggestion. The new paper is based on a collection of crinoids obtained from Philippine waters by the U.S. Fisheries steam-vessel *Albatross*. This collection includes not only a remarkably large number of new forms, but likewise examples of species previously known only by more or less imperfect specimens.

IN the December (1908) number of the *Annals and Magazine of Natural History*, Mr. R. Kirkpatrick, of the British Museum (Natural History Department), described two very remarkable new types of calcareous sponges, for which he proposed the generic names Minchinella and Merlia. These sponges bear many resemblances to some of the fossil Pharetronids, and are extraordinarily different from any other living forms. The history of the specimens is curious. Minchinella was found in an old bottle of *Challenger* material, still in an admirable state of histological preservation! Merlia was represented by some dry and stony-looking fragments which had been given to Canon Norman, F.R.S., by a Madeiran naturalist. Being anxious to investigate the minute anatomy of Merlia, Mr. Kirkpatrick recently visited a small island near Madeira with dredging apparatus, and after much hard work succeeded in obtaining living specimens, which he preserved in a variety of ways for minute histological investigation, so that we may expect shortly to have a full account of this interesting genus.

IN *Man* for February Mr. H. C. Brown gives an account of a curious device for cheating death practised in Burma. In this case, after a death in the family, one of the survivors was warned in a dream that the death of a child would follow. Accordingly, a bamboo was cut exactly the length of the body of the child, pieces of his hair and nails were enclosed in it, and the whole, as a representative of the child, was solemnly interred. The device failed to produce the desired effect, the mourners on their return from the mock funeral finding the child dead.

DR. G. F. BLACK, of the New York Public Library, has undertaken a useful but difficult task in preparing a bibliography of the literature connected with the Gypsies. The preliminary draft which he has issued, and for which he invites additions and corrections, is intended to include not only separately published books and pamphlets, but also the vast fugitive literature of the subject, papers in the proceedings of learned societies, reviews, and the like. The British Museum Catalogue, the Berlin *Orientalische Bibliographie*, the Leipzig *Geschichte und Sprache der Ziguener*, and the *Bibliographia* in Colocci's *Gli Zingari* have all been laid under contribution. Even as it stands, this bibliography will be of much assistance to students of the history, sociology, and linguistics of this mysterious race, and it may be hoped that the compiler will receive the hearty cooperation of European and Oriental scholars in bringing it to a successful completion.

MR. SHEPPARD, the energetic curator of the Hull Museum, describes in his annual report for the past year the steady increase of the collections under his charge. Among recent additions in the department of antiquities are a bronze sword, 22 inches in length, found at Leven, near Hull, the largest implement of its class which up to the present has been discovered in that vicinity, and a fine collection of vases of the early English period from the cemetery near South Cave. The order Arachnida has been specially studied by local naturalists, and one of this class, *Erigone spinosa*, from the east Humber bank, is new to Britain. Gifts to the museum of an old pannier saddle and various domestic appliances of the Stuart, Georgian, and Early Victorian periods, now rapidly disappearing, suggest that other provincial museums would be well advised to imitate Hull in forming a special collection of such objects. Mr. Jacobs, chief engineer of the Pennsylvania Railway and Hudson Tunnels Co., New York, has presented to the museum a valuable model, made to scale in brass and steel, of the great tunnel shield used in the excavations carried on under his control. This, in view of a recent scheme for tunnelling the Humber, has proved to be a most attractive exhibit.

MR. E. O. GREENING discusses in "One and All Gardening" annual for 1909 the problem of town gardens for the poor, and describes the experience of the Vacant Lands Association, formed with the object of acquiring waste lands in the metropolis, if only temporarily, to turn into allotments. Thus in Fulham a piece of land comprising seven acres provided space for fifty-eight plots; land was also secured in East London and Balham. The annual also contains a pithy article, by Mr. R. L. Castle, on the French system of intensive cultivation, with a description and illustrations of the gardens worked by women gardeners at Thatcham, in Berkshire.

A SHORT part (vol. xii., part v.) of the Contributions from the United States National Herbarium is assigned to the descriptions, by Mr. H. Pittier, of some new plants from Central America. The most interesting are three new species of Carpotroche, a genus of the Flacourtiaceæ, from Costa Rica. The flowers are characterised by their styles and a winged ovary, and the succulent fruit is produced by the development of pulp from an aril-like outer layer of the seeds. The discovery of these species extends the distribution of the genus, formerly known only from Brazil. Another discovery of two new species of Phyllonoma (Saxifragaceæ), also in Costa Rica, bridges a gap in the distribution of that genus, which had previously been collected in Peru, Columbia, and Mexico.

IN the *Comptes rendus de la Société impériale des Naturalistes de St. Pétersbourg* (vol. xxxix., part i.) two new epiphyllous lichens collected in the Caucasus are described by Messrs. A. A. Elenkin and N. N. Woronichin. The phenomenon of lichens growing on leaves, except in the tropics, is very rare; a former instance from the Caucasus was recorded by Mr. Elenkin some years ago, and in all three cases the lichens were taken on box leaves. Of the two new species, one, in which gonidia of the Chlorococcus type were associated with apothecia, is assigned to the genus Sporopodium; the other was indeterminable, as only pycnidia of the fungus were obtained, and the alga, which was intracellular, is doubtfully referred to Trentepohlia.

DETERMINATIONS of plants collected by Dr. A. Weberbauer in the Andes supply the main item in the first part of vol. xlii. of Engler's *Botanische Jahrbücher*. Numerous additions are recorded for the genera Palaua and Malvastrum (Malvaceæ), Tibouchina and Miconia (Melastomaceæ), Schefflera (Araliaceæ), and Lantana (Verbenaceæ). In connection with the recent discussion at the Linnean Society, attention should be directed to the article by Dr. H. Schenck on the phylogeny of the bryophytes and ferns, in which he presents a carefully prepared argument in favour of a descent from the brown algæ, notably from Dictyota. The antheridia and archegonia of these groups are considered to be homologous with the plurilocular gametangia, while the spore mother-cell is regarded as homologous with the tetrasporangium of Dictyota.

THE Deutsche Seewarte (Hamburg) has published its meteorological year-book for 1907, the thirtieth volume of the series, containing observations and results at ten stations of the second order, and hourly readings at four normal observatories. These carefully prepared tables follow the usual form adopted by all the German States, based upon the international scheme, and we note that the gravity correction is now applied to the barometrical observations. As in former years, statistics relating to all storms which have affected a considerable area of the German coasts are given; these are prepared from observations at fifty-seven storm-signal stations, and furnish very useful data for reference; October was the only month in which no storms were recorded. An appendix gives a summary of the contents of all the German meteorological year-books for the year 1907.

THE meteorological statistics of the Colorado College Observatory for 1907, compiled by Mr. F. H. Loud, have been received. This institution has an exceptionally good supply of self-recording and other instruments, many of which were presented by General W. J. Palmer, who has for some years provided for the expense of reducing and publishing the observations. The tabular results are prepared with great care; *e.g.* the daily means of temperature are obtained from hourly tabulations of a Richard thermograph, and the extremes shown by the maximum and minimum thermometers are checked by the same thermograph. The wind is resolved into four component parts (instead of two), as recommended by Prof. A. von Oettingen, of Yuriev, and others. The mean temperature of the year was 48°·2, no reading being below zero (F.), whereas in 1905 the minimum was −22°. The monthly range was not less than 63° in each of the months February–May; the spring is always a very critical time for cultivation. The rainfall was under 10 inches, little more than two-thirds of the ordinary fall.

AN elaborate series of experiments has been undertaken at the Physikalisch-technische Reichsanstalt, Charlottenburg, the results of which appear in the *Deutsche Mechaniker-Zeitung* for February 1. Altogether 454 single sensitivity tests were made—ninety-six in a water bath at 40° C., 222 in the mouth, and 136 in the arm-pit. By sensitivity is understood the time taken by the thermometers in assuming the constant temperature of the water bath or of the human body. According to the author, Mr. H. F. Wiebe, it would appear possible to increase the sensitivity of clinical thermometers in general, and to manufacture actual minute thermometers to indicate correctly by measurements in the mouth in one or even in half a minute. It seems improbable to make minute thermometers for use in the arm-pit which will take up the temperature of the body in one minute, at least so far as glass thermometers are concerned. In order to obviate errors in this connection, when using clinical thermometers it would be desirable to supply instructions for their use,

in which it should be set forth that in taking measurements under the arm the thermometers should be allowed to lie for five minutes before the reading is taken.

MESSRS. SCHEEL AND HEUSE have published in the February number of the *Zeitschrift für Instrumentenkunde* the results of some investigations undertaken by them on the methods of producing high vacua. The tests were carried out on the Gaede pump, the Toepler pump, Reden and Rosenthal's mercury pump, and on charcoal in liquid air used in connection with the air pump. The resultant pressures were measured by the McLeod vacuum gauge, the authors having found (*Verhandlungen der deutschen physikalischen Gesellschaft*, vol. xi., p. 1) that this method could be applied for the measurement of the lowest pressures. The most important result was that obtained by employing charcoal prepared from cocoa-nut shell, and using this charcoal, in liquid air, in conjunction with an air pump (Gaede's), the initial pressure of 0·006 millimetre being derived from the pump. A vacuum of 0·00001 millimetre was obtained and kept up for some time by this method. Complete tables of readings, and a full description of the experiments, are given in the article.

AN interesting report of trials on a complete steam plant at the Greenvale Mill, Littleborough, near Manchester, is given in *Engineering* of February 26. The trials were made under the direction of Mr. G. B. Storie, consulting engineer, of Rochdale, and his report is of special interest on account of the very full results given. The plant includes a Brush-Parsons parallel-flow steam turbine developing 500 kilowatts at 3000 revolutions per minute and 200 lb. per square inch steam pressure. Mr. Storie finds its thermal efficiency at 91·8 per cent. of the rated power to be 18·27 per cent., the efficiency ratio by comparison with the Rankine cycle being 0·579. It is unusual to find a report on a steam turbine containing information regarding the pressure, temperature, and degree of superheat of the steam at the end of each stage of the expansion, and it would be very useful if other experimenters would take Mr. Storie's report as an example in this respect. There has been a tendency to withhold such information in the past. Special attention may be directed to the following table of results showing the importance of maintaining a good vacuum with steam-turbine plants :—

Barometer, 29·29 *inches*.

Steam pressure at entrance to turbine—lbs. per sq. inch	163	163	164	161	162	156	157	158
Steam temperature at entrance to turbine—degrees F. .	524	526	530	530	533	512	528	530
Vacuum—inches of mercury	28·29	27·1	26	25·15	24·05	23	22	21
Kilowatts	275	275	276	275	273	270	270	263
Pounds of steam consumed per kilowatt-hour	18·54	19·63	20·65	21·63	22·34	23·33	23·7	24·25

A PAPER on some recent grain-handling and storing appliances at the Millwall Docks, by Mr. Magnus Mowat, read before the Institution of Civil Engineers on March 2, contained some interesting facts about grain elevators. The installation now provides for the discharge and weighing of 550 tons of grain per hour *ex* ship, and for its delivery either partly or wholly into granary, silo, or barge. The elevators which come in contact with the ship's hold are of the pneumatic or suction type. The granary and silo elevators are of the bucket type, and, like the band-conveyers, are of two-ply woven cotton, impregnated with rubber. These bands have a total length of 2¾ miles; they are electrically driven. In the waterway there is a dolphin, alongside which the ship is moored. This is a wooden jetty of greenheart timber, 350 feet by 24 feet, placed 50 feet clear of and parallel with the quay. On its deck are four suction elevators, each of 75 tons per hour capacity, corresponding with the respective holds of the ship. The machinery within the dolphin includes four pairs of exhauster pumps, each 46 inches diameter by 60 inches stroke, which maintain in the grain-receivers on the top of the towers a partial vacuum of 7 inches to 10 inches of mercury. Flexible pipes connect the receiver with the ship's hold, and the grain is elevated to a height of 80 feet by the inrushing air, the proportion of air being controlled by nozzles with adjustable sleeves. The grain separates itself from the air in the receiver, and automatically discharges through "tippers" at the bottom of the chamber into hoppers which feed the weighing machines. These deliver through steel shoots into barges, or connect with the quay by band-conveyers on bridges spanning the intervening water-space. The band-conveyers within the granary and subways under the quay are endless, and are supported at 6-feet intervals by steel rollers on cast-iron standards, tied longitudinally by steel angles on each side; their speed is 552 feet per minute. The bands and elevators form a series for mechanically conveying the grain from the dolphin elevator to the roof of the granary, from which it is distributed to the various floors by gravity through pipes provided with sleeves and doors for housing and delivery to or from any section.

WE have received from Messrs. John Wheldon and Co., of Great Queen Street, London, W.C., a copy of their latest catalogue of geological works, containing particulars of 1761 publications they have on sale. The books concerned include selections from the libraries of the late Prof. Ramsay, Dr. R. Hunt, Prof. J. Percy, Prof. Phillips, Mr. William Topley, and Dr. Flight.

MR. FRANCIS HODGSON has published the sixth volume of the second series of the Proceedings of the London Mathematical Society. The record deals with meetings of the society held from November, 1907, to June, 1908, and the papers read on these occasions, short abstracts of which have appeared already among our reports of societies and academies. The volume also contains obituary notices of the late Lord Kelvin and Mr. C. Taylor.

OUR ASTRONOMICAL COLUMN.

ANOMALOUS REFRACTION AND SPECTROHELIOGRAPH RESULTS.—Having spent some time, in August, 1907, at the Mount Wilson Observatory, and having employed the splendid equipment there in a number of experiments, Prof. Julius has derived further confirmation of his theory that some of the phenomena seen on various spectroheliograms are, at least in part, due to the anomalous refraction which waves from the vicinity of absorption lines must suffer when passing through an absorbing medium of varying densities. The experiments and the results obtained are described and discussed in No. 5, vol. xxviii., of the *Astrophysical Journal*.

By selecting lines at different distances from the sodium, D, lines, and passing the rays through a tube containing sodium vapour, in which the density gradients could be controlled, Prof. Julius was able to obtain photographs showing the effects of anomalous refraction, and he shows that equivalent conditions probably exist in the solar atmospheres. Should the further work which is to be carried out on these lines prove confirmatory, it will no longer be necessary to explain "dark" and "bright" flocculi by the assumption of very marked differences in the absorbing and emitting conditions of a certain gas or vapour in contiguous regions on the sun, for the anomalous refraction

caused by the existence in the sun of irregular density-gradients, comparable in magnitude with the vertical gradient in the earth's atmosphere, will explain them efficiently.

THE CONSTITUTION OF THE SUN.—In No. 1, vol. xxix., of the *Astrophysical Journal*, Herr J. F. Hermann Schulz again brings forward the theory that the nucleus of the sun is in a liquid state. This theory, in its earlier forms, was propounded by Kirchhoff, modified by Zöllner, and, about twenty years ago, advocated by Herr Schulz, but the prevailing ideas concerning the sun's temperature then rendered it improbable.

However, in the light of the recent researches of Moissan and others, from which it may be deduced that the mean temperature of the sun is about 5400° C., Herr Schulz believes that a liquid nucleus best explains the observed phenomena, and on these lines he revives his theory. He further argues that various stellar phenomena may be explained on the assumption that many stars, too, are not entirely gaseous. The paper in which the discussion was included was read before the last meeting of the Astronomische Gesellschaft in Vienna, September, 1908, and also appears as an abstract from the *Vierteljahrsschrift der Astronomischen Gesellschaft*, part iv., 1908.

Still another solar theory is expounded in No. 4305 of the *Astronomische Nachrichten*. In this paper M. A. Amaftounsky, of Kichineff, explains the phenomena of sun-spots, metallic and gaseous prominences, sun-spot zones, &c., on the assumption that spots are caused by the out-rush of heated vapour from the sun's lower atmosphere, and the filling in of the funnels thus formed by the photospheric clouds. The agreement of observed phenomena with the phenomena which would follow were the theory correct is discussed in detail.

RADIAL VELOCITY OF α PERSEI.—From thirty-seven spectrograms of α Persei, taken by Prof. Küstner and Dr. Zurhellen between August, 1904, and March, 1906, Herr F. Goos has derived values for the radial velocities of the star during that period. Previous observers have found that the variation of the velocity is small or non-existent.

In the present investigation Herr Goos made eight settings, each way of the plate, on twelve iron lines which are taken as standards, and found that the velocity, relative to the sun, varied between −3·65 km. and 0, the probable error for each plate being ±0·40 km. (*Astronomische Nachrichten*, No. 4300, p. 50).

A CATALOGUE OF 1625 SOUTHERN STARS.—Vol. ii. of the "Meridian Observations of the Perth Observatory (W. Australia)" contains the results of the meridian observations of 1625 stars between 39° and 41° south declination. As explained by Mr. Ernest Cooke, the director of the observatory, in the introduction, these results form part of the scheme undertaken by the Perth Observatory to determine, from time to time, the accurate positions of some 8000 stars lying in the zone 31°–41° S. declination. The positions now given are reduced to the equinox of 1900·0 at the epoch of observation, and, when known, the proper motions, for reduction to epoch, are also given.

THE MELBOURNE OBSERVATORY.—Mr. Baracchi's report of the work done at the Melbourne Observatory during the period 1906 December 1 to 1908 April 30 shows that the observatory is, apparently, now well established as a purely astronomical institution, the meteorological work having been transferred to the new Weather Bureau, under the Commonwealth Government, from the end of 1907.

The long-vacant post of chief assistant has now been filled by Mr. J. M. Baldwin, an 1851 Exhibition scholar, who has further qualified for the post by visiting and working at a number of English, Continental, and American observatories.

Mr. Baracchi reports, concerning the astrographic chart work, that, to April 30, 1908, 707 Sydney plates, containing 430,468 stars, and 991 Melbourne plates, containing 318,025 stars, were completely measured. The report concludes with a strong recommendation that, in accordance with the suggestion of the Solar Union, supported by the Royal Society, a solar physics observatory should be founded in Australia, preferably at Adelaide.

SCIENTIFIC AID FOR THE BRITISH TENANT FARMER.

THE various agricultural colleges founded or subsidised by the county councils take a wide view of their functions, and not only give instruction in agriculture to young men wishing to take up this subject, but also carry out field experiments designed to instruct those who are already farming, and who will not or cannot attend lectures. The field experiments are not strictly in the nature of research work, since they do not usually involve any new principles; they are not always arranged to give all the results they might, but, taken as a whole, they serve the very useful purpose of demonstrating to the farmer certain facts which he ought to know, but often does not, and of giving him opportunities of seeing for himself the effect of special manures on crops or of special feeding stuffs on animals.

The results of the field trials are published in pamphlet form by the college or department concerned, and widely distributed among the farming community. Recently the Board of Agriculture started a summary of these reports in its journal, and the idea is a very useful one. The South-Eastern Agricultural College publishes its reports in the form of an annual journal, while the University of Cambridge has periodically brought out full reports dealing with the whole of its experiments in the counties.

In the nature of the case, many of the reports issued are of local rather than of general interest, and do not call for any full treatment here, but a few instances may be quoted to show the type of work being done. Experiments at the University College of Wales, Aberystwyth, have been made to find out what ration will prove profitable for fattening bullocks. The fact that animals require a tolerably large maintenance ration (*i.e.* that they eat a fair amount of food without gaining in weight) renders it necessary that fattening should be rapid, but the difficulty then arises that a large ration gives proportionately less increase in weight than a small one. Up to a certain point an increase in the ration is profitable; beyond this point the profit gradually decreases, and loss arises. Prof. Jones has illustrated these facts very well in the report before us.

The Northumberland experiments deal with pasture problems. It has been demonstrated that basic slag is the most effective manure for economically improving the heavy soils of Northumberland, and a mixture of basic slag and a potash manure is best on the lighter soils. It has also been shown that second, and even third, dressings of slag are quite as effective as the first. The mangel experiments have shown that nitrate of soda gives better results than sulphate of ammonia, that slag is more effective than superphosphate, that sulphate of potash is better than the muriate, and that common salt much increases the crop. Experiments on other crops are also recorded.

Rather different results were obtained in the Scotch experiments on pastures summarised by Mr. Hendrick. Basic slag led to an improvement, but not much, and three or four years elapsed before sufficient return was obtained to pay for the slag. However, the improvement lasts, and can be seen six years afterwards, so that the method is profitable. No other manure was found to give profitable returns. This report gives analyses of the soils, and is therefore much more interesting than those in which soil analysis is ignored.

The West of Scotland Agricultural College has issued reports by Prof. McAlpine. The experiments on varieties of oats made during the years 1902–7 are summarised, and the effect of manures is discussed. Manuring has but little influence on the kernel weight, and only very slightly increases the proportion of kernel to husk.

The Lancashire County Council experiments were designed to test the relative value of limestone and of burnt lime for improving pastures, and the conclusion is drawn that limestone is the more effective, provided it contains 95 per cent. of calcium carbonate and is ground to a sufficiently fine state.

The farmer has not only to produce crops and beasts, but to sell them, and success in one branch of his pro-

fession does not necessarily imply success in the other. No amount of field experiments will make the farmer into a successful business man, but there is one way in which he can rely on getting the full value of his produce—by cooperation. Only in this way can the small farmer hope to buy and sell to the best advantage, and to make anything out of market fluctuations that are capable of yielding profit. This question is discussed in the *Quarterly Review* by "Home Counties," whose interesting article deserves to be widely read.

In conclusion, no notice of current agricultural publications intended for the tenant farmer would be complete without reference to the leaflets of the Board of Agriculture, which deal in simple manner with a large variety of important topics. Every effort is made to ensure that these leaflets should reach the men for whom they are intended.

THE BRITISH SCIENCE GUILD.

THE verbatim report of the third annual meeting of the British Science Guild, held at the Mansion House on January 22, has just been issued. We give extracts from the speeches made by Sir William Ramsay and Sir Frederick Pollock.

After referring to the work done by the Guild during the year, summarised in NATURE of January 28, Sir William Ramsay said:—"The greatest danger, I think, from which we suffer is this inherent one in the minds of so many of us, that it is not necessary to prepare beforehand for events which we can perfectly well prophesy will happen. I want to draw attention to one subject which I think a committee of the Guild ought to consider. It is not merely of the utmost importance to ourselves as a race, but it is of the greatest importance taken in connection with any legislative proposals of any Government. Let me give you an example from private life. No doubt most of us, perhaps all, have made our wills. We prepare, in a sense, for death. That is to save our successors from a considerable amount of trouble. Again, if we are well, we safeguard ourselves. We do not go into infected places, we indulge in exercise, we take a reasonable amount of sleep—in fact, we try to keep well; and if we fall ill from any chance we call in a doctor and take other measures to cure ourselves. In other words, we try our best to prolong our lives. Now, it appears to me that one of the duties of the State is to prolong the life of the nation. What does the life of the nation depend on? It depends not only upon the fitness of the people, but upon the amount of natural energy which is available to be used for driving power. We know pretty well from the results of the Royal Commission that our coal mines will not last for an indefinite time. Some say three hundred, others eight hundred years. Let us put it at five hundred. We can turn our minds back to the year 1400. We certainly did not know the people of England in those times, but many of us have a very lively knowledge of the sort of people they were and what they have done for us. They did great things in developing the country, building many churches, carrying out reforms according to their lights. We are now enjoying the benefits of what they did. Is it not only right and natural that we ought to have some consideration for persons living three or five hundred years hence? It does not need many "greats" before "grandson" until that time is reached in the picture of the mind—probably only six or seven. We ought in the present day to have consideration for the generations who will succeed us, and who will either profit by our foresight or regret our stupidity. Now, in this country our water-power is quite insignificant, and, indeed, if it were much larger than it is there is not much to be made of it. It has been calculated that the total water-power of Europe, excluding, perhaps, some few rivers in northern Russia, is equal to 2,000,000 horse-power. Why, we use 100,000,000 horse-power in England, so that even if we possessed the whole water-power of Europe we should hardly be supplying one-fiftieth of what we use from coal. I know there is a popular superstition that in view of the extraordinary inventions which we are witnessing in these days—long-distance telegraphy and so on—something will be discovered in the future which will replace our present source of energy. One cannot say with absolute certainty that that will not happen, but I think any scientific man will say it is in the highest degree improbable. And what else have we to come and go upon? You may say that we might have an apparatus to utilise the tides; but the first storm knocks to bits any apparatus. Or solar heat? Again the first storm plays havoc with any machinery—and that of the costliest. One possibility is to dig a big hole deep enough into the earth and hope to get boiling water. Well, curiously enough, to-day's *Morning Post*, in its "Discovery and Invention" column, describes how Mr. Parsons has considered that very question. He says that to bore a hole twelve miles deep would cost 5,000,000*l.* and take eighty years. If we are going to bore that hole, ladies and gentlemen, it is time we began. Joking apart, without that possibility, there is no other source of energy. Now this points to the economisation of coal. It points to legislation in other directions. Are we going to limit the use of steam engines? Gas engines give us about three times the power for the same consumption of fuel. Are we going to pay attention to the afforestation of the country, so that when coal is done we shall still have wood? Are we going to stop the enormous loss of nitrogen, which is so serious, that it will be impossible after fifty years to get the necessary amount for the growth of our plants? Are we going to utilise our sewage? All these are questions of first importance, and I think the Guild should appoint a committee to see how we can save the waste that is going on, and so give our country a chance of longer life. It would be horrible to look forward to London becoming a fishing village of five to ten thousand people, built on the top of some magnificent ruins and supported by scanty agriculture. But it is only what we should have to look forward to unless something is done. Let us postpone that evil day as far as possible."

Sir Frederick Pollock, in moving that the annual report be adopted, said:—"I have been asked to say a few words on the Patents Act, 1907, and to explain that the new matter in that Act, the only matter which attracts public attention, is not a revolutionary enactment or a breach with any established fiscal policy, but a revival of principles upon which the whole of our legislation for patents started, and on which it has been continued. In the earliest days of grants to inventors, the King exercised the power of granting monopolies at his own will and pleasure. In the course of the sixteenth century strong and well-founded objections were raised to the indiscriminate granting of monopolies, and it came to be accepted as a principle that monopolies ought to be granted to inventors only on condition of their being able thereby to introduce new industries into the kingdom. That was assigned as the consideration for which monopolies were granted. And further, during the early history of this branch of monopolies, which ultimately became the foundation of our modern Patent Law, it was understood that the inventor was bound, not only to work his invention within the kingdom, but to teach the use of it to all who desired to learn it. Those principles continued to be observed until comparatively modern times. But from some time in the latter part of the eighteenth century the principle of effectively introducing the new invention to this country was rather lost sight of, and it was supposed that the rule of publishing the invention, so that any competent person could learn from the specification to make it and work it for himself, would be sufficient for the protection of the public. In recent days it has been found that specification is not enough, for it was discovered that there was such a thing as the "obstructive" working of patents. That might be done in two ways. A man might acquire an invention, not for the purpose of introducing it to this kingdom, but, on the contrary, to stifle it and prevent it from being worked at all. That is a point which has, I think, been rather overlooked in some of the public discussions on this subject. I believe that that mischief existed, and that it was quite proper to put an end to it. The other obstructive way was for foreign manufacturers to take out or buy up a British patent, and so get a practical monopoly by being able to stop anyone from manufacturing the invention here. It is obvious that in both these ways "unfair prejudice" might

be created against British manufacturers or against endeavours to establish new industries in this country. Now "unfair prejudice" in the Act does not mean successful competition, a sense in which the word is sometimes used. "Unfair prejudice" is a novel term, but "unfair competition" is now a recognised head of law in all civilised countries, though the words are less familiar here than in America.

"That, so far as I know, is the history of the new provisions of the Patents Act of 1907. If you read Section 24, the operative section, which has really been the text of these few remarks, together with Section 38, you will see that the object of the Act is not the protection of manufacturers against rival producers as producers, but the protection of the public, both producers and consumers, against the evils of excessive monopoly.

"I should like to say one word on the decline of the study of German. For about thirty years we have been in danger of attaching a slightly exaggerated value to German as compared with other modern languages. Now, it appears, there is a reaction in favour of French. So far as the study of French is concerned, I have not a word to say against it, but that the study of German should be declining seems to me, as to the framers of the report—and to my learned friend, if I may still call him so, Mr. Haldane—a matter of serious national importance. I can think of only two reasons why people should prefer French to German. They may suppose French to be easier, or they may suppose it to be more useful. As to being easier—and I must say it dogmatically, because there is no time to give reasons—having given much time to the study of both, I believe French is really the harder language to learn well. As to being more useful, French is certainly very useful indeed. Taking literature and business all round, perhaps one may say that French is more useful for the literary study of our own language and the history of our own civilisation, but when you come to business—and therein I include what is being done abroad in science and the application of science to industry—German is quite as important as French. Finally, it is becoming more and more indispensable to have a knowledge of foreign languages for any branch of life whatever."

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illustrated; Les Bases physico-chimiques de la Chimie analytique, Herz, illustrated; La Théorie des Courants alternatifs, A. Russell, illustrated. *Harper and Brothers.*—The Life of the Universe, Prof. Svante Arrhenius. *Longmans and Co.*—Spinning Tops and Gyroscopic Motion, H. Crabtree, illustrated; Electric Furnaces: the Production of Heat from Electrical Energy and the Construction of Electric Furnaces, Prof. W. Borchers, translated by H. G. Solomon, part ii., illustrated. *Macmillan and Co., Ltd.*—Physical Science in the Time of Nero: being a Translation of Seneca's "Quæstiones Naturales," J. Clarke, with notes on the subject-matter by Sir A. Geikie, K.C.B., P.R.S. *John Murray.*—The Interpretation of Radium, F. Soddy (The Progressive Science Series), with diagrams. *The Oxford University Press.*—Elements of Non-Euclidean Geometry, B. J. L. Coolidge. *Kegan Paul and Co., Ltd.*—Music: its Laws and Evolution, J. Combarieu (International Science Series); Periodic Law, A. E. Garrett (International Science Series). *The Rationalist Press Association, Ltd.*—The History of Astronomy, Prof. G. Forbes, F.R.S. *The University Tutorial Press, Ltd.*—Geometry, Theoretical and Practical, section vi., Solid Geometry (Euclid xi.), W. P. Workman and A. G. Cracknell.

MEDICAL SCIENCE.

F. Alcan (Paris).—Le Diabète sucré, Lepine; Les aliénés Voyageurs, Joffroy and Dupouy. *Baillière, Tindall and Cox.*—Differential Diagnosis of Bacteriology, E. P. Minett and R. C. P. London. *Cassell and Co., Ltd.*—Health and Common Sense, W. Hutchinson; Mind and Work, M. H. Gulick; Parenthood and Race-culture: an Outline of Eugenics, Dr. C. W. Saleeby. *A. Constable and Co., Ltd.*—The Fluids of the Body, Prof. E. H. Starling, F.R.S. *John Lane.*—The Medical Diseases of Children, R. Miller. *Methuen and Co.*—Drugs and the Drug Habit: Chapters on the Dynamics of a Remedial Particle, Dr. H. Sainsbury. *John Murray.*—Children in Health and Disease, Dr. D. Forsyth; Problems in Animal Metabolism, J. B. Leathes (new edition). *J. Nisbet and Co., Ltd.*—Injuries and Diseases of the Knee-joint, considered from the Clinical Aspect, Sir W. H. Bennett, illustrated; Movable Kidney, W. Arbuthnot; Hip Disease in the Young, J. Berry; Prostatectomy, J. W. T. Walker; Enuresis, J. H. Thursfield; Some of the Common Affections of the Tongue, J. Hutchinson; Some Clinical Points in the Surgery of the Intestine, F. C. Wallis; The Operative Treatment of Chronic Constipation, W. A. Lane, illustrated. *G. P. Putnam's Sons.*—The Art of Natural Sleep, with Definite Directions for the Wholesome Cure of Sleeplessness, illustrated by Cases Treated, L. P. Powell. *Rebman, Ltd.*—Text-book of Special Pathology, Drs. Beattie and Dickson, illustrated; Text-book of Hyperæmia as Applied in Medicine and Surgery, Prof. A. Bier, authorised translation from the fifth revised German edition by Dr. G. N. Blech, illustrated; Atlas of Clinical Surgery, with Special Reference to Diagnosis and Treatment, for Practitioners and Students, Dr. P. Bockenheimer, English adaptation by Dr. C. F. Marshall, 3 vols., illustrated; Surgery of the Upper Abdomen, Drs. Deaver and Ashhurst, in two volumes, vol. i., Surgery of the Stomach and Duodenum; vol. ii., Surgery of the Liver, Gall Bladder, Pancreas, and Spleen, each illustrated; The Oral Cavities: an Elementary and Practical Treatise on the Diseases of the Pharynx and Larynx, Dr. E. J. Moure, authorised translation by Dr. J. M. Farquharson, illustrated; Clinical Commentaries deduced from the Morphology of the Human Body, Prof. A. De Giovanni, translated from the second Italian edition by J. J. Eyre. *George Routledge and Sons, Ltd.*—The Family Doctor: a Dictionary of Domestic Medicine and Surgery especially adapted for Family Use, Dr. E. Barrett, illustrated; Infant Feeding by Artificial Means: a Scientific and Practical Treatise on the Dietetics of Infancy, S. H. Sadler (new edition), illustrated. *Swan Sonnenschein and Co., Ltd.*—Exercises for Heart Affections, based on the Nauheim Treatment, Dr. J. G. Garson, illustrated. *Williams and Norgate.*—International Archives of Malaria, edited by C. M. Cassel; Epilepsia: being an International Quarterly Review devoted to the Study of Epilepsia and Kindred Diseases from Pathological, Therapeutical, and Social Aspects.

METALLURGY.

Edward Arnold.—The Dressing of Minerals, Prof. H. Louis, illustrated. *A. Constable and Co., Ltd.*—Welding and Cutting of Metals by the Aid of Compressed Gases and Electricity, Dr. L. A. Groth, illustrated; The Precious Metals, Dr. T. K. Rose, illustrated. *E. and F. N. Spon, Ltd.*—Metallurgical Calculations, J. W. Richards, part iii., The Metals other than Iron.

TECHNOLOGY.

A. Constable and Co., Ltd.—The Manufacture of Paper, R. W. Sindall, illustrated. *Crosby Lockwood and Son.*—Marble and Marble Working: a Handbook for Architects, Sculptors, Marble Quarry Owners and Workers, and all engaged in the Building and Decorative Industries, W. G. Renwick, illustrated. *E. and F. N. Spon, Ltd.*—Sugar: Handbook for Planters and Refiners, J. A. R. Newlands and B. E. R. Newlands, illustrated.

MISCELLANEOUS.

F. Alcan (Paris).—La Crise du Transformisme, Le Dantec. *Wm. Blackwood and Sons.*—Studies in European Philosophy, J. Lindsay. *Chatto and Windus.*—A History of Babylonia and Assyria from the Earliest Times until the Persian Conquest, L. W. King; vol. i., A History of Sumer and Akkad: being an Account of the Primitive Inhabitants of Babylonia from the Earliest Times to about B.C. 2000; vol. ii., A History of Babylon from the Period of the First Dynasty, about B.C. 2000, until the Conquest of Babylon by Cyrus, B.C. 539; vol. iii., A History of Assyria from the Earliest Period until the Fall of Nineveh before the Medes, B.C. 606. *Kegan Paul and Co., Ltd.*—The Liturgy of Funerary Offerings, Dr. E. A. W. Budge; The Book of Opening the Mouth, Dr. E. A. W. Budge, 2 vols.; The Book of the Dead, Dr. E. A. W. Budge (new edition), 3 vols. *Sir Isaac Pitman and Sons, Ltd.*—Body and Soul, P. Dearmer, a Study of "Christian Science" and "Faith Healing" from the Psychological and Physiological Aspects. *G. P. Putnam's Sons.*—Beverages, Past and Present: an Historical Sketch of their Productions, together with a Study of the Customs connected with their Use, E. R. Emerson, 2 vols.; The Law of Psychic Phenomena: a Working Hypothesis for the Systematic Study of Hypnotism, Spiritism, Mental Therapeutics, &c., T. J. Hudson (new edition). *Swan Sonnenschein and Co., Ltd.*—A translation of Hegel's Phenomenology of Mind, J. B. Baillie (Library of Philosophy); Thought and Things: a Study of the Development and Meaning of Thought or Genetic Logic, Prof. J. M. Baldwin, 3 vols., vol. iii., Real Logic; The History of Philosophy: based on the Work of Dr. J. E. Erdmann (fifth edition, revised by his son, Dr. W. Bruno Erdmann), W. S. Hough; Valuation: its Nature and Laws, Prof. Urban (Library of Philosophy); Physiological Psychology, Prof. W. Wundt, a translation of the fifth and wholly re-written German edition by Prof. E. B. Titchener, in 3 vols., vol. ii., illustrated. *The University Tutorial Press, Ltd.*—Principles and Methods of Physical Education and Hygiene, W. P. Welpton; The Science of Speech: an Elementary Manual of Phonetics for Teachers, B. Dumville.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—Sir E. Ray Lankester, K.C.B., F.R.S., has been invited to deliver the Huxley lecture for the present session.

Dr. David Fraser Harris has been appointed lecturer in physiology to succeed Dr. Rhodes, who has resigned.

CAMBRIDGE.—The Public Orator, Dr. Sandys, spoke as follows on Thursday, March 4, in presenting Dr. Sven Anders Hedin for the degree of Doctor of Science *honoris causa*:—

Scandinaviae filium intrepidum, post tot pericula peregre suscepta denuo Britannis redditum, Academiae totius nomine libenter salutamus. Salutamus quattuor universitatum illustrium alumnum insignem, qui et Persiam et Mesopotamiam et Caucasi montes et regiones trans mare Caspium late patentes olim peragravit, quique postea per annos decem Asiam mediam ter penetravit, ter scientiarum

spolia plurima victor reportavit. Quid commemorem camporum praecelsorum longitudines infinitas, quid nivis aeternae solitudines immensas ab eodem perlustratas? Quid grandinis saxeae tempestates intolerabiles fortiter toleratas? Quid montium ignotorum labyrinthos inextricabiles identidem pererratos? Quid Trans-himalayae lacus procellosos, quid fluminum ingentium fontes audacter exploratos? Ibi originem illam tricipitem primus conspexit, e qua rex fluviorum, Brahmae filius nuncupatus, itineris longi cursum Indiam in orientalem dirigit. Idem in eadem regione rupem illam humilem primus detexit, unde Indus ipse exortus Indiam in occidentalem, Alexandri magni victoriarum olim conscius, defluit.

Atqui (ut poëtae verbis utar)

> "Magnus Alexander totum cum vicerat orbem,
> Non potuit sese vincere; maius erat."

Hic autem, et sui ipsius et rerum naturae victor Alexandro felicior, etiam trans Asiam interiorem scientiarum imperium fortiter propagavit. Idem, Alexandro humanior, terram periculis plurimis plenissimam sic obiit, ut in regione tam immensa nullum crudelitatis, nullum inhumanitatis, vestigium reliquerit.

Ergo laurea nostra libenter coronamus virum a Societate Regia Geographica numismate aureo plus quam semel merito donatum, philosophiae doctorem illustrem, Sven Anders Hedin.

The next combined examination for sixty-seven entrance scholarships and a number of exhibitions at Pembroke, Gonville and Caius, King's, Jesus, Christ's, St. John's, and Emmanuel Colleges, will be held on Tuesday, December 7, and following days. Mathematics, classics, and natural sciences will be the subjects of examination at all the above-mentioned colleges. Some of the colleges allow candidates who intend to study mechanical sciences to compete for scholarships and exhibitions by taking the papers set in mathematics or natural science. Forms of application for admission to the examination at the respective colleges may be obtained as follows:—Pembroke College, W. S. Hadley; Gonville and Caius College, The Master; King's College, W. H. Macaulay; Jesus College, A. Gray; Christ's College, Rev. J. W. Cartmell; St. John's College, The Master; Emmanuel College, The Master, from any of whom further information respecting the scholarships and other matters connected with the several colleges may be obtained. The colleges desire it to be known that any candidate for a scholarship may signify in writing his wish not to receive the emolument of the same if elected thereto, and that such candidate may be elected to a scholarship which may be honorary only and without emolument, but shall carry with it all other privileges attached to the position of a scholar. The amount thus set free will serve to increase the number of scholarships or exhibitions open to other candidates.

The syndicate appointed to obtain plans and estimates for the new museum of archæology and ethnology has reported that it has now in hand more than 10,000*l.*, more than half of which has been contributed by members of the Foster family in memory of Mr. W. K. Foster. The syndicate is of opinion that leave should be asked of the Senate to commence at once the first portion of a building which will contain, when completed, a museum, lecture-rooms, class-rooms, library, workrooms, and private rooms for the curator and staff. Some of these rooms will be available for the meetings of the Cambridge Antiquarian Society.

The special board for physics and chemistry, and the special board for history and archæology, have issued schedules for the examination in architectural studies under the following headings:—(1) practical mathematics; (2) elementary applied mechanics; (3) strength of materials and elementary theory of structures; (4) descriptive geometry: projection of solids; (5) the principles of surveying; (6) outlines of the history of architecture of Europe and the Near East; (7) outlines of the general history of art; (8) architecture and the allied arts of the Classical period; (9) architecture and the allied arts of the Mediæval period; (10) architecture and the allied arts of the Renaissance and Modern periods; (11) the theory of art in relation to architecture.

LONDON.—With reference to the statement in NATURE of March 4, that "the Senate has taken exception to the terms of reference to the Royal Commission on the University," Sir William Ramsay, as a member of the Senate of the University, present during the whole of the meeting on March 3, requests us to make public the fact that that statement is without foundation. The note did not refer to the meeting on March 3, that being the day on which NATURE went to press; and our correspondent informs us it was based upon the official announcement made in the *Times* and other papers on February 26, though it failed to express exactly the substance of that announcement.

THE issue for 1909 of the "Schoolmaster's Year-book and Directory" is now available. The general character of the volume remains unaltered; the directory has been made much more complete, and the very large amount of information provided has been brought up to date. This annual work of reference continues the most convenient available source of particulars concerning every grade of secondary education for boys, and no schoolmaster should be without a copy.

IT is announced by *Science* that the 40,000*l.* required to secure the gift of 120,000*l.* from Mr. John D. Rockefeller for the Harper memorial library at the University of Chicago has now been obtained. Part of the money has been reserved for an endowment. The president of Western Reserve University announces the completion of a 100,000*l.* fund for the additional endowment of Adelbert College and the college for women. Of this amount 25,000*l.* was offered by the General Education Board, on the condition that 75,000*l.* be raised by the University. Hamline University, St. Paul, Minn., has been offered 15,000*l.* by the General Education Board of New York on the condition that it will raise three times the amount, making a total of 60,000*l.*, a large portion of which is to be added to the permanent endowment of the University. The department of engineering of the University of Michigan has received a gift of the library of the late Mr. George Y. Wisner and a rotary engine of the value of 1400*l.* from Mr. J. D. R. Lampson. The University of Virginia has completed an endowment fund of 200,000*l.*, of which half has been given by Mr. Andrew Carnegie.

THE Board of Education has now published the second part of "Statistics of Public Education in England and Wales, 1906–7–8." This Blue-book (Cd. 4506) is concerned wholly with financial statistics. It is interesting to find that the net total expenditure during the school year 1907–8 of the Board of Education out of the Parliamentary vote was 13,272,017*l.*, and that 11,129,658*l.* was expended on elementary education. Under the headings "secondary schools, pupil teachers, &c.," the amount disbursed was 679,612*l.* To quote the summary of payments, the grants made for "technical institutions, schools of art, day technical classes, art classes, and other schools and classes for further education" reached 456,573*l.* The share of the Parliamentary vote which went to higher scientific education appears very small, as the following items show:—Royal College of Science, London, 24,843*l.*; Imperial College of Science and Technology, 5,783*l.*; Geological Museum and Geological Survey, 21,255*l.*; and Committee on Solar Physics, 1899*l.* These amounts probably do not quite account for the total amount which should be credited to higher scientific instruction, because fractions of the expenditure under "works and furniture" and "museums and circulation of objects for exhibition" were probably devoted to the purposes of education in science.

THERE are many indications that eventually we shall have a science of education, and it is satisfactory to find that the number of persons engaged in educational work who are learning the value of the results of carefully and scientifically planned experiments steadily increases. The training college authorities in different parts of the country are beginning to take an active share in this important work, and the spread of scientific methods in their institutions is reflected in the second issue of the *Training College Record* which has reached us. Among other important articles contained in this excellent magazine we notice that by Prof. Green on experiment in education,

in which he gives a helpful summary of the more important educational experiments inaugurated in this and other countries during 1908. Dr. Percy Nunn describes briefly a pedagogical museum which is being arranged at the London Day Training College; the arts of reading and of clear speech are discussed ably by Prof. Wyld and Principal Burrell; and Mr. H. H. Hulbert deals with the teaching of hygiene in training colleges. The other contributions similarly indicate that the age of empiricism and the blind adherence to the *obiter dicta* of departed writers on education is giving place to an attempt to understand by observation and by suitable tests the working of the child mind and the ways in which it is influenced by environment and other conditions.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 26, 1908.—"The Proportion of the Sexes produced by Whites and Coloured Peoples in Cuba." By Walter **Heape.**

This paper deals with data contained in publications issued by the chief sanitary officer of Cuba, 1904–5–6, in which are recorded the sex of both legitimate and illegitimate births and still-births for both classes of the population. The totals dealt with amount to 177,704, viz. whites 135,881, and coloured peoples 41,823 births and still-births. It is found:—

(1) That there is a racial difference in the proportion of the sexes produced; for whites, 108·44 males, for coloured, 101·12 males, per 100 females. This result is in close agreement with other published statistics of both races, and shows the influence of heredity.

(2) That for both races, for both births and still-births, there is a consistent variation in the proportion of the sexes produced by legitimate as compared with illegitimate union. For whites, legitimate 109, illegitimate 105·95 males per 100 females. For coloured, legitimate, 107·73, illegitimate 97·91 males per 100 females. Illegitimate unions result in a marked increase in the proportion of females produced, and it is claimed that they are chiefly induced by individual physiological conditions affecting the metabolic activity of the woman.

(3) That both whites and coloured experience two sharply defined breeding seasons each year; sudden, brief bursts of reproductive activity, correlated with marked climatic changes, which tend to increase individual metabolic activity. Again, at these times of greatest fertility the largest proportion of females is produced.

(4) That a considerably higher proportion of females are born in towns than in country districts, where life is associated with greater hardships.

(5) Conclusions: although heredity, in the main, governs the proportion of the sexes produced by these two races, conditions occur under which that proportion is varied, and although different in degree it is similar in character for both races. These conditions are directly associated with forces which affect the metabolic activity of the mother, and suggest the probability that the ripening and production of ovarian ova of different sexes is influenced thereby. Thus it is held that a struggle for existence is always going on among the sexual ovarian ova, and that these extraneous forces influence the result. Speaking generally, this investigation indicates that the greater the metabolic activity of the ovary the more females are produced.

January 14.—"On the Passage of Röntgen Rays through Gases and Vapours." By J. A. **Crowther.** Communicated by Sir J. J. Thomson, F.R.S.

A series of experiments has been made, under comparable conditions, on the behaviour of different gases and vapours with respect to the passage of Röntgen rays through them. The results obtained are thus summarised:—

(1) The amount of ionisation produced by the direct action of the primary Röntgen rays on a gas is simply proportional to the pressure of the gas. No evidence was obtained of the emission of any appreciable amount of soft secondary radiation by the gas, the ionisation being apparently due to the direct action of the primary rays.

(2) The relative ionisation in the different gases, compared with air as the standard, varies considerably with the hardness of the rays. Hydrogen and ethyl bromide show an increase as the hardness of the rays increases. Other gases remain constant or give a diminution. There is no indication of any approximation to a "density law" as the hardness of the rays is increased.

(3) The relative ionisation in a gas follows approximately an additive law. It does depend somewhat, however, on the state of combination, especially for soft rays.

(4) The absorption varies with the pressure according to an exponential law.

(5) The amount of secondary radiation emitted by different gases relative to air is, generally, approximately independent of the hardness of the primary rays. For very hard rays ethyl bromide shows a slight decrease. On the other hand, the values for methyl iodide increase fairly rapidly as the hardness of the rays is increased.

(6) The coefficient of absorption of the secondary rays emitted by a gas, in the gas itself, is not abnormal.

(7) The total ionisation in different gases is not a constant, and the relative values obtained differ with the hardness of the rays.

(8) The amount of energy required to produce an ion in different gases is different, and also varies with the hardness of the rays.

No relationship has been found between the relative ionisation and the secondary radiation, or between either, and any other known property of the gases and vapours, and the explanation of the relatively large amounts of secondary radiation emitted by ethyl bromide and its class compared with air, and of the large relative ionisations in methyl iodide, ethyl bromide, &c., still remains to be sought.

It appears that on the whole less energy is required to produce an ion in the more ionisable gases, but the values obtained do not differ very largely, and are totally inadequate to explain the very large amounts of ionisation in these gases and vapours.

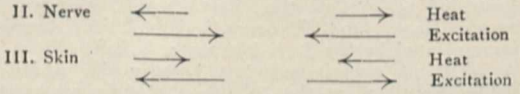
Both the ionisation and the secondary Röntgen radiation follow, at any rate approximately, an additive law. It appears, therefore, that these properties are properties of the atoms themselves, and that an explanation must be sought in their atomic structure.

February 25.—Sir Archibald Geikie, K.C.B., president, in the chair.—The statistical theory of the form of the curve of oscillation for the radiation emitted by a black body: Prof. H. A. **Wilson.** The view adopted in this paper is that the radiation from a black body is an irregular disturbance subject to statistical laws. It is shown that these laws can be deduced from the distribution of energy in the spectrum, and that they enable the character of the disturbance to be described. The disturbance at any instant is taken to be the sum of the displacements in the infinite number of simple harmonic vibrations of arbitrary phases which are obtained when the radiation is dispersed into a spectrum. Expressions are found for the chances that the displacement and its derivatives lie between given limits. These expressions enable the average number of zero values per cm. of the displacement and its derivatives to be calculated. The distribution of maxima and minima is estimated, and a curve has been drawn having approximately the statistical properties deduced. The mean wave-length (λ') of the radiation is defined as $2/n_0$, where n_0 is the average number of zeros per cm. in the displacement curve. If λ_m denotes the wave-length in the spectrum at which the energy is a maximum, it is shown that $\lambda'/\lambda_m = 2{\cdot}5$. It is shown that the number of maxima and minima is about double the number of zero values and about half the number of points of inflection in the curve.—The flight of a rifled projectile in air: Dr. J. B. **Henderson.** The problem is attacked from first principles simply as a case of a moving rotating body meeting with certain resistances due to the air, and it is found that all the known phenomena are accounted for by the precessional motions of the shot, due to the tilting and friction couples which arise from the obliquity of the axis of the projectile to the direction of motion. The complete trajectory in all its details can be thus constructed from the initial conditions and the laws of resistance so soon as these are

known. By assuming laws of resistance, the details of portions of trajectories are sketched by the traces which the direction of the axis of the shot and the direction of motion would leave on the celestial sphere. Mr. Mallock has also studied the physical phenomena of a moving projectile from the same point of view in a paper on ranges and behaviour of rifled projectiles in air (Proc. Roy. Soc., June 6, 1907), and the two interpretations of the phenomena agree in their common portion. Mr. Mallock's object, however, is to obtain an expression for the drift of the projectile, which he does by assuming that the axis follows the tangent to the trajectory. The present paper is concerned with the *details* of the motion, the deviations of the axis from the tangent, and with the method by which the axis approximately follows, on the average, the tangent to the trajectory. It is found that in the details lies the explanation of the horizontal and vertical "drifts."

—The cross-breeding of two races of the moth *Acidalia virgularia*: Louis B. **Prout** and A. **Bacot.** The authors undertook extensive systematic breeding experiments with the geometrid moth *Acidalia virgularia* (Hübner) with the view of ascertaining whether there were any "Mendelian" behaviour discoverable in the cross-pairing of two well-marked local races, the dark London form and a white form from the south of France (Hyères). Between the years 1906 and 1908, ten generations were bred and analysed, the number of specimens being between 5000 and 6000. In each generation the two pure strains were maintained, and cross-pairings obtained between them, and many of the hybrids were also carried on to the succeeding generations, although some failed at one point or another. The results were entirely negative so far as Mendelian segregation is concerned. Hybrids of the first generation presented a facies intermediate between those of the parent stocks, and seldom varying materially. Their offspring, and the succeeding generations, showed usually a greater variability and a tendency—though indefinite and unsystematic—to revert to, or towards, the original pure forms, but the intermediate or hybrid forms were scarcely ever "bred out," and intergrades from one extreme to the other were so gentle that attempts to sort out hybrid broods into "darks" and "lights" gave only the merest approximations. A few selected pairings, *e.g.* of light × light *ex* hybrid, resulted in the recovery of nearly pure strains, so far as it was possible to test them, but nothing peculiar to any special theory of heredity was deducible from them. The authors consider that the behaviour of this hybridisation is confirmatory of that of certain races of *Lasiocampa quercus*, on which Mr. Bacot had earlier experimented (*Entomologist's Record*, vol. xiii.), namely, that the bringing together of geographically separated races may be expected to result in the production of blends, and that it will therefore be necessary, in order to obtain segregation of the parental forms in a hybrid race, to pair aberrations inhabiting the *same* geographical area, where it may be assumed that natural selection has, for some reason, virtually eliminated the intermediates. All the recorded instances of this Mendelian segregation with which the authors are acquainted among the Lepidoptera are of this latter class, the forms the pairing of which has produced it being well-defined "aberrations" in the sense in which that word is used by Staudinger, *e.g. Triphaena comes* with ab. *curtisii*, *Xanthorhoë ferrugata* with ab. *unidentaria*, *Abraxas grossulariata* with ab. *varleyata*, *Callimorpha dominula* with ab. *rossica*, &c. Some incidental observations on the inheritance of some minor characters in the wing-markings, or, in one strain, of manifest ♀ sex-predominance, are noted as probably worthy of further attention, though outside the scope of the present inquiry.

March 4.—Sir Archibald Geikie, K.C.B., president, in the chair.—The presence of hæm-agglutinins, hæm-opsonins, and hæmo-lysins in the blood obtained from infectious and non-infectious diseases in man, second report: L. S. **Dudgeon.** *Haemo-lysins.*—It was found that the blood in fourteen cases of typhoid fever showed hæmolysis on nine occasions. Those instances in which hæmolysis occurred when the immune serum was added to normal red cells terminated fatally. In the remaining cases this action was demonstrated when normal serum was added to the immune red cells. Auto-hæmolysis was proved twice, once during an attack of paroxysmal hæmoglobinuria; the other case was tertiary syphilis. Iso-hæmolysis was found several times when normal serum was added to immune red cells, less frequently with immune serum added to normal erythrocytes. *Haem-agglutinins.*—Auto-agglutination was an extremely rare phenomenon. In one instance spontaneous and auto-agglutination occurred. In this case auto-hæmolysis was also proved. Further experience has shown that iso-agglutination occurs in normal blood, but not auto-agglutination. Hæmolytic agglutinins are present whenever hæmo-lysins can be demonstrated. The specificity of hæm-agglutinins has been proved, and the absolute specificity of bacterial and hæm-agglutinins has been completely demonstrated. The agglutination resulting from the interaction of a serum and certain red cells could be completely prevented by previously saturating this serum with the heated (60° C. for one hour) specific red cells. Saturation of the serum with melanin failed to produce any effect. *Phagocytosis.*—Hæmo-phagocytosis was often well marked. The phenomenon usually resulted from the interaction of immune red cells, normal serum, and normal leucocytes. Hæmo-lysins, agglutinins, and opsonins might be present together in a certain sample of serum, or the opsonins and agglutinins together, or opsonins singly. Usually, the agglutinins and opsonins had a distinct relationship.—The influence of glucosides on the growth of acid-fast bacilli, with a new method of isolating human tubercle bacilli directly from tuberculous material contaminated with other micro-organisms, preliminary note: F. W. **Twort.** This investigation was undertaken to test the action of acid-fast bacilli on the glucosides and to see how far any fermentation reactions obtained would differ with the various strains of human and bovine tubercle bacilli tested, and also to obtain, if possible, a better medium on which to isolate and grow tubercle bacilli. In all, forty-three glucosides were tested with acid-fast bacilli, including human and bovine tubercle bacilli, but there was no evidence of fermentation with any of the glucosides. One glucoside, *ericolin*, was found to kill off a large number of species of micro-organisms, especially bacilli of the Colon group and various cocci, but had very little effect on the acid-fast group of bacilli. By means of this glucoside the isolation of tubercle bacilli directly from human sputum contaminated with other organisms becomes quite easy. The glucoside should be made up with distilled water in a 2 per cent. solution; a lump of sputum is then placed into a test-tube containing the ericolin and placed at 38° C. for three-quarters of an hour to one hour; subcultures are then made on to Dorset's egg medium, and pure growths of tubercle bacilli will be obtained in fourteen to twenty-eight days; the tubes are sometimes contaminated with a few other organisms, chiefly tiny colonies of Streptococci and slow-growing colonies of organisms of the Streptothrix group, but they are so few that they in no way interfere with the tubercle colonies, which can be easily subcultured.—The effect of heat upon the electrical state of living tissues: Dr. A. D. **Waller.** *Method.*—The tissue—muscle, nerve, or skin—is led off to the galvanometer by two electrodes, A, B. Warmth is applied by brief glow of a platinum wire under (not in contact with) A or B. *Results* are as follows:—



The arrows under A and B indicate the direction of currents in the tissue in response to local warmth or local excitation at A and at B respectively, *e.g.* if muscle led off at A and B to the galvanometer is heated at B, there is current in the galvanometer from B to A, in the muscle from A to B, as indicated by the first arrow under B. The local skin-currents both to heat and to excitation are of reverse direction to those of muscle (and of nerve),

e.g. if skin, led off by electrodes A and B applied to its external surface, is warmed at B there is a current in the galvanometer from A to B ("ingoing" current at B, or B "negative" to A). If it is excited at B there is current in the galvanometer from B to A ("outgoing" current at B, or B "positive" to A). The internal surface is ineffective. Both surfaces of scalded skin are ineffective. *Conclusion.*—In muscle (and in nerve) where the electrical effect of local excitation is "negative," the effect of moderate heat is "positive." In the skin where the electrical effect of local excitation is "positive," the effect of moderate heat is "negative." Excessive heat, producing injury, gives a "negative" effect in muscle (and nerve), a "positive" effect in the skin. Thus in all three cases—muscle, nerve, and skin—the electrical effect of moderate heat is of the opposite sign to that of excitation.

Royal Microscopical Society, February 17.—Sir E. Ray Lankester, K.C.B., F.R.S., president, in the chair.—The "red snow" plant (*Sphaerella nivalis*): Dr. G. S. **West.**—A German-silver portable microscope made by Powell in 1850: A. A. C. E. **Merlin.**—The measurement of very minute microscopic objects: E. M. **Nelson.**—The transformation of certain insects: F. **Enock.**—The fresh-water Crustacea of Algeria: Mr. **Gurney.**

EDINBURGH.

Royal Society, February 15.—Prof. A. Gray, F.R.S., vice-president, in the chair.—The electromotive force of iodine concentration cells with one electrode saturated with iodine: Principal A. P. **Laurie.** The paper dealt with the question as to what was the distribution between iodine ions and I_3 ions in saturated solutions of iodine and potassium iodide, the strength of the latter being increased up to normal. This was determined by measuring the electromotive force of iodine concentration cells with a known and very small quantity of iodine round one electrode and a saturated solution of iodine round the other, the potassium iodide being of the same strength in both cases. With the view of correcting the error due to contact electromotive force between KI_3 and KI, an intermediate solution of ten normal ammonium nitrate was introduced. The results show that up to a strength of normal potassium iodide there are no higher polyiodides formed beyond KI_3, the increasing solubility of iodine being due to an alteration in the ratio of the dissociation of I_3 into I_2 and I.—The magnetic properties of certain copper alloys: A. D. **Ross** and R. C. **Gray.** The paper was an investigation of the effects on magnetic quality of annealing, quenching, baking, and liquid-air tests on manganese-aluminium bronzes, in which the relative proportion of manganese and aluminium was constant, while the content of copper varied. Comparison was made with similar effects in manganese, manganese bronze, manganese steel, aluminium bronzes, and very pure copper. It was shown that the effects obtained in Heusler's alloy present a suggestive similarity to those in free copper.—Some low-temperature experiments in magnetism: J. G. **Gray** and Hugh **Higgins.** According to Dewar and Fleming, a specimen of steel when magnetised to saturation at room temperature, and then cooled and warmed alternately between −190° C. and 5° C., arrived at a reversible condition in which its magnetic moment at −190° was greater than its magnetic moment at 5°. In the present paper the specimen was magnetised at −190° and subjected thereafter to the same treatment. The reversible condition was arrived at after the first warming, and the percentage increase then brought about by cooling was much greater than that which held for the specimen when magnetised at the room temperature.—Lagrange's equations of motion and elementary solutions of gyrostatic problems: Prof. A. **Gray.** The first part of the paper was a new discussion of the difficulties in applying Lagrange's equations to what are known as non-holonomic systems. The modified form of the equations which can be applied was given. The elementary solutions depended upon the generalisation of a theorem the fundamental nature of which could be indicated by the rule that the normal force on a particle moving in a circle was equal to the momentum multiplied by the angular speed of the radius vector.

PARIS.

Academy of Sciences, March 1.—M. Émile Picard in the chair.—The supposed effect of crystallisation for modifying the properties of the solution of a body resulting from the direct union of two solutions: D. **Gernez.** The author has repeated an old experiment, according to which a solution of the double tartrate of sodium and ammonium, or of sodium and potassium, possesses a different rotatory power according as the substance has been crystallised out or not. This result is not confirmed; the rotatory power of the mixed tartrates is not affected by crystallisation, followed by subsequent solution.—A physico-chemical method of sterilising in the cold and at a distance: A. **Billon-Daguerre.** The ultra-violet rays from an arc lamp kill *Staphylococcus pyogenes aureus* in five or six seconds.—The monogenic function of a hypercomplex variable in a commutative group: Léon **Autonne.**—The hypothesis of positive electrons. Reply to the note of A. Dufour: Jean **Becquerel.** The experiment described by Dufour is not a repetition of the one given by the author. While not supposing that the hypothesis of positive electrons is the only one capable of explaining the observed facts, it is worthy of consideration, since it coordinates and explains a number of magneto-optic phenomena.—Molecular volumes, densities, and atomic weights: A. **Leduc.** From the formula given in a previous paper the densities (oxygen taken as unity) of twenty gases are calculated, and the calculated numbers compared with the experimental figures. The atomic weights deduced from these figures (O = 16) are:—H = 1·0075, N = 14·005, C = 12·004, Cl = 35·463, and S = 32·072.—Equilibria between the liquid and solid phases in the mixture $NaCl + H_2O$. The fusion of snow: Camille **Matignon.** The complete curve for the lowering of the melting point by the addition of NaCl is given. The eutectic mixture contains 30·7 per cent. of salt, and solidifies at −21°·3.—The determination of some physical constants of the peptones: L. **Lematte** and A. **Savès.** The peptones used contained 16·8 per cent. of nitrogen and 0·756 per cent. of chlorine as HCl. Solutions of concentrations between 0·9 per cent. and 10 per cent. of peptones were examined for freezing point, density, and refractive index, and the results given in a table.—The action of gaseous hydrochloric acid on amorphous silicon: A. **Besson** and L. **Fournier.** In this reaction the authors have isolated two new products, SiH_3Cl (boiling point about −10°) and SiH_2Cl (boiling point about +12°).—The ammoniacal iridium sulphates: Marcel **Delépine.**—The action of carbon monoxide upon chromium, nickel, manganese, their oxides and alloys: Georges **Charpy.** At 1000° C. nickel is practically without action on carbon monoxide; manganese gives a mixture of MnO and carbon, and chromium resembles manganese, but the action is slower.—Researches on the occluded gases contained in some common metals: B. **Delachanal.** The metals examined were aluminium, magnesium, zinc, tin, spongy platinum, platinum foil, and platinum-iridium. Analyses of the gases evolved are given.—The condensation of the mesoxalic esters with aromatic hydrocarbons: A. **Guyot** and G. **Estéva.** The condensation of mesoxalic esters with benzene and its derivatives under the action of sulphuric acid takes place in two stages, an aryl-tartronic ester, $X.C(OH).(CO_2R)_2$, being first formed, and then a diaryl-malonic ester, $X_2.C(CO_2R)_2$. Numerous preparations are described showing the generality of the method.—Elaterine and some of its derivatives: A. **Berg.**—The action of semicarbazide on chlorinated aldehydes: André **Kling.**—New very sensitive reactions for the detection and identification of glycerol: Georges **Denigès.** The glycerol is oxidised by bromine water to dioxyacetone, and application made of the various colour tests described in a previous note.—The experimental production of white and black tubercles, starting with seeds of pink radish: Marin **Molliard.**—The antagonism of sodium and calcium citrates in the working of the heart and its moderating nerve apparatus: H. **Busquet** and V. **Pachon.**—The course of the oxidation and hydrolysis of starch and its constituents under the action of hydrogen peroxide: Mme. Z. **Gatin-Gruzewski.** There are distinct differences between the modes of transformation of amylose and amylopectin by diastases and by hydrogen

peroxide.—The action of light upon milk to which potassium bichromate has been added: A. **Gascard.** Milk samples to which potassium bichromate has been added as a preservative keep much better in the dark.—The sterilisation of milk by the ultra-violet rays: Victor **Henri** and G. **Stodel.** By the use of quartz mercury lamps milk can be completely sterilised in the cold.—Relations between the mode of development of Tetracorallia and that of Hexacorallia: L. **Faurot.**—The volcano of Eglazines, Aveyron: G. **Fabre.**—The modifications of the coast of Poitou: the comparison with other points of the shore of the Atlantic Ocean: M. **Welsch.**—The variations of the distribution of the atmospheric pressure at the surface of the globe: Henryk **Arctowski.**—The laws of the distribution of temperature with height at different latitudes and under different meteorological conditions: L. Teisserenc **de Bort.**

DIARY OF SOCIETIES.

THURSDAY, MARCH 11.

ROYAL SOCIETY, at 4.30.—Note on the Stability of Jacobi's Ellipsoid: Sir George H. Darwin, K.C.B., F.R.S.—On the Wave-lengths of Lines in the Secondary Spectrum of Hydrogen: H. E. Watson.—The Measurement of Dielectric Constants by the Oscillations of Ellipsoids and Cylinders in a Field of Force: Prof. W. M. Thornton.

ROYAL INSTITUTION, at 3.—Recent Advances in Agricultural Science: A. D. Hall.

MATHEMATICAL SOCIETY, at 5.30.—The Kinetic Image of a Convected Electric System in a Conducting Plane Sheet: Prof. J. Larmor.—On an Integral Equation: G. H. Hardy.—The Transformation of the Electrodynamical Equations and the Laws of Motion: H. Bateman.—The Transformation of the Electrodynamic Equations of Moving Bodies: E. Cunningham.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Dielectric Strength of Compressed Air: E. A. Watson.

FRIDAY, MARCH 12.

ROYAL INSTITUTION, at 9.—Modern Submarine Telegraphy: S. G. Brown.

PHYSICAL SOCIETY, at 8.—The Effect of Radiations on the Brush Discharge: A. E. Garrett.—On Pirani's Method of Measuring the Self-inductance of a Coil: E. C. Snow.—Exhibition of a High Potential Primary Battery: W. S. Tucker.—On the Least Moment of Inertia of an Angle Bar Section: H. S. Rowell.

MALACOLOGICAL SOCIETY, at 8.—Description of a New Species of Oliva from the Andaman Islands: F. G. Bridgman.—Notes on the Genera Cypræa and Trivia: H. O. N. Shaw.—On the Shell Mound at Sidon; On the Habitat of Certain Species of Clausilia from the Coast of Syria: Rev. H. A. Cooke.—Notes on the Species of Cyclophorus found at Hong Kong: Staff-Surgeon K. H. Jones, R.N.—On the "Conchological Illustrations," by G. B. Sowerby, jun., and the "Descriptive Catalogue of Shells," by J. E. Gray: C. Davies Sherborn.—On the Date of Issue of Sowerby's "Conchological Illustrations": H. O. N. Shaw.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Observations of the Partial Eclipse of the Sun, 1908 December 23, at Natal Observatory: E. Nevill.—Note on Mr. Franks's Analysis of the Colours and Magnitudes of 3630 Stars: Julia Bell.—The Brightness of Saturn, with Ring Invisible: J. M. Baldwin.—Radial Movement of Sun-spots: J. Evershed.—On the Data employed in Oppolzer's Canon der Finsternisse: E. Nevill.—Comparison of the Ancient Eclipses of the Sun with Modern Elements of the Moon's Motion: Simon Newcomb.—On Correlation and the Characters of Variable Stars: in reply to Prof. Karl. Pearson: H. C. Plummer.—The Recent Pendulum Observations in India: Major Lenox-Conyngham.—On the Relation between the Period and Density of the Algol Variables: Rev. J. Stein.—On a Chinese Planisphere: E. B. Knobel.—Occultations of Planets by the Moon in 1909, visible at British Observatories: A. M. W. Downing.—Note on the Regnal Years in the Elephantine Papyri: J. K. Fortheringham.—Some Notes on Aberration: Prof. H. H. Turner.

SATURDAY, MARCH 13.

ROYAL INSTITUTION, at 3.—Properties of Matter: Sir J. J. Thomson, F.R.S.

MONDAY, MARCH 15.

VICTORIA INSTITUTE, at 4.30.—Legislations of Israel and Babylonia: H. M. Wiener.

TUESDAY, MARCH 16.

ROYAL INSTITUTION, at 3.—The Evolution of the Brain as an Organ of Mind: Prof. F. W. Mott, F.R.S.

ROYAL SOCIETY OF ARTS, at 4.30.—The Colonial Wool Trade: S. Bank Hollings.

ZOOLOGICAL SOCIETY, at 8.30.—Grouse-Disease Committee Reports: (*a*) Ectoparasites of the Grouse; (*b*) The Thread-worms (Nematoda) of the Red Grouse (*Tetrao scoticus*); (*c*) The Tape-worms (Cestoda) of the Grouse. Appendix: Parasites of Birds allied to the Grouse: Dr. A. E. Shipley, F.R.S.—On a Fossil Bird from the Lower Pliocene: W. P. Pycraft.—On a Collection of Mammals from Western Java, presented to the National Museum by Mr. W. E. Balston: Oldfield Thomas, F.R.S., and R. C. Wroughton.

ROYAL STATISTICAL SOCIETY, at 5.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Further discussion*: Concrete and Masonry Dam Construction in New South Wales: L. A. B. Wade.

WEDNESDAY, MARCH 17.

ROYAL SOCIETY OF ARTS, at 8.—The Musical Aspect of Drums: Gabriel G. Cleather.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—Wind Waves in Water, Sand, and Snow: Dr. Vaughan Cornish.

ROYAL MICROSCOPICAL SOCIETY, at 8.—The Optical Examination of a Crystal Section in a Rock Slice: Dr. J. W. Evans.

ENTOMOLOGICAL SOCIETY, at 8.

THURSDAY, MARCH 18.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: An Attempt to Detect some Electro-optical Effects: Prof. H. A. Wilson, F.R.S.—On the Influence of their State in Solution on the Absorption Spectra of Dissolved Dyes: Dr. S. E. Sheppard.—The Ferments and Latent Life of Resting Seeds: Jean White.

ROYAL INSTITUTION, at 3.—Recent Advances in Agricultural Science: A. D. Hall.

LINNEAN SOCIETY, at 8.—The Dry-rot of Potatoes: Miss Sibyl Longman.—The Structure and Affinities of *Davidia involucrata*, Baill.: A. Horne.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Experiments upon the Forces acting on Twist-drills when operating on Cast-iron and Steel: D. Smith and R. Poliakoff.

FRIDAY, MARCH 19.

ROYAL INSTITUTION, at 9.—Experiments at High Temperatures and Pressures: Richard Threlfall, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Some Aspects of Chemical Engineering: C. J. Guttmann.

SATURDAY, March 20.

ROYAL INSTITUTION, at 3.—Properties of Matter: Sir J. J. Thomson, F.R.S.

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