THURSDAY, FEBRUARY 28, 1907.

SCHOOL MATHEMATICS.

(1) *Trigonometry for Beginners.* By J. W. Mercer. Pp. xi+351. (Cambridge: University Press, 1906.) Price 4*s*.

(2) *Trigonometry for Beginners.* By Rev. J. B. Lock and J. M. Child. Pp. vii+195. (London: Macmillan and Co., Ltd., 1906.) Price 2*s*. 6*d*.

(3) *Geometry: an Elementary Treatise on the Theory and Practice of Euclid.* By S. O. Andrew. Revised edition. Pp. xii+218. (London: John Murray, 1906.) Price 2*s*.

(4) *Modern Commercial Arithmetic.* Part i. By G. H. Douglas. Pp. 163. (London: Macmillan and Co., Ltd., 1906.) Price 1*s*. 6*d*.

(5) *A New Shilling Arithmetic.* By C. Pendlebury, assisted by F. E. Robinson. Pp. xii+176+xxxiv. (London: George Bell and Sons, 1906.) Price, with answers, 1*s*. 4*d*.

(6) *Junior Arithmetic Examples.* By W. G. Borchardt. Pp. viii+171+xl. (London: Rivingtons, 1906.) Price 1*s*. 6*d*.

(7) *Clive's New Shilling Arithmetic.* Edited by Dr. W. Briggs. Pp. viii+160. (London: W. B. Clive, University Tutorial Press, Ltd., 1906.) Price 1*s*.

(8) *Junior Practical Mathematics.* By W. J. Stainer. Pp. x+350. (London: George Bell and Sons, 1906.) Price 3*s*.

(9) *A Rhythmic Approach to Mathematics.* By Edith L. Somervell, with a preface by Mary Everest Boole. Pp. 67. (London: George Philip and Son, Ltd., 1906.) Price 2*s*. 6*d*. net.

(1) MR. MERCER possesses a fine conception of how trigonometry should be presented to youths, and his book is admirable and altogether good. The development of the subject is very gradual indeed, and is constantly enforced by means of concrete examples, systematic computations, practical geometry, and by judicious graphs. Thus the first ten chapters are confined to the development of the simple trigonometrical ratios, that is, to the solution and application of right-angled triangles, under all sorts of conditions, such as in problems of elementary surveying, the resolution of vectors, areas, solutions of triangles in general, &c., and later on additional illustrations of right-angled triangles occur in the chapter on traverse tables. Four-figure mathematical tables, including logarithms, are in constant use, and careful attention is paid to arrangement and checking of the numerical work. After this thorough grounding, angles of any magnitude are introduced, and triangles are solved by general formulæ, a useful table of log. haversines being here provided. Then the radian measure of an angle is explained, and the treatment becomes more abstract, the final chapters dealing with multiple and submultiple angles, transformation formulæ, identities, equations, and inverse notation. Finally, there are two hundred miscellaneous examples grouped in sets of five, and collected answers to the very numerous exercises distributed throughout the book. The author is to be congratulated on having produced a very notable textbook on elementary trigonometry, and one that is worthy of adoption in the secondary, technical, and public schools throughout the country.

(2) Messrs. Lock and Child, like the author just noticed, start with the very laudable idea of presenting the subject in a more practical and less abstract form than is commonly met with, and they are successful, though not to the same extent as in the previous case. Their development of the subject is not so finely graduated; they have not sufficiently recognised the fundamental importance of the right-angled triangle, and their special five-figure tables, without differences, though compact, become tedious in use and necessitate undue attention being given to the theory of proportional parts, a side issue. The opening chapters of the book are geometrical, and contain descriptions of practical methods of measuring angles, both of azimuth and of elevation, a detailed description of the sextant and theodolite being reserved for a later chapter. Suitable exercises and test papers are provided at intervals, and the work concludes with answers and an index. The book contains many good features, and can be recommended especially to students preparing for the examination of the Board of Education in mathematics, stage 2.

(3) As the result of increased experience, and also to meet the requirements of examiners, the subject-matter of Mr. Andrew's well-known "Geometry" has been re-arranged and added to, while preserving the excellent features of the original work. Thus the first seven chapters are mainly experimental, practical, and quantitative, and with the "intimate first-hand knowledge" of geometry thus obtained the learner is well prepared for the theoretical work of the next chapter, in which formal proofs are given, arranged in logical sequence. The deductive method is employed in subsequent work, which deals with similar figures, the solution of triangles, solid geometry and projection, and the mensuration of geometrical solids. The plan and scope of the book are excellent, and in its revised form the manual will deservedly appeal to an increasing number of readers.

(4) The "Commercial Arithmetic" by Mr. Douglas is a very interesting work. Assuming the student to possess a knowledge of the fundamental rules of arithmetic, the author begins with examples of the tabular arrangement of numbers, with checks, labour-saving devices, and contracted and approximate methods in addition, subtraction, multiplication and division, and with the decimalisation of money. In the chapter on the calculation of prices we find some very neat methods of working. For example, since $365=240+120+5$, we have 365 at, say, 8*d*. each $=$ 8*l*. + 4*l*. + 3*s*. 4*d*. $=$ 12*l*. 3*s*. 4*d*. In dealing with percentages, commission, discount, and profit and loss, examples of commercial book-keeping are given, and there is the same regard for special and rapid methods of computation. In the calculation of simple interest for a specified number of years and days, an ingenious method known as the "third, tenth, tenth" is much used. The table given on p. 88 for finding the

number of days between any two dates would be improved by a grouping of the rows. Subsequent chapters deal with compound interest, various kinds of discount, bills of exchange, shares, mixtures, and with examples involving general tables of weights and measures, English and French. Collected answers are given at the end, and altogether the book is very cleverly written, and seems eminently suited for use on the commercial side of the numerous technical and secondary schools of the country.

(5) This book is practically the authors' "Junior Arithmetic," with the chapters on the first four rules replaced by sets of examples for revision. It is intended for the middle and lower forms of secondary schools, and is specially adapted to the requirements of the Oxford, Cambridge, and Scotch local examinations and the like. The explanations of the rules are condensed, and the book contains a very large collection of examples, and is printed both with and without answers.

(6) The volume by Mr. Borchardt is based on the author's "Arithmetical Types and Examples," but with many additions; the explanations and statements of the rules are left entirely to the teacher, the sets of examples being well chosen and carefully grouped. The book is suitable for use under conditions similar to those stated under No. 5.

(7) Clive's "New Shilling Arithmetic" is mainly a collection of exercises and problems, with such statements and definitions of rules as a pupil might profitably commit to memory. It covers largely the same ground as the two previous books, all three having been much influenced by the recent reforms in mathematical teaching. The book can be had with answers at a small extra cost.

(8) The "Junior Practical Mathematics" is intended for use in preparatory and public elementary schools and in the lower forms of secondary schools. The book is divided into two parts, which may be obtained either separately or together, and with or without answers. Part i. is mainly arithmetical, but the numerical work is supplemented throughout by algebraical and graphical work. This part contains, amongst other things, the four simple rules, practice, brackets, areas, volumes and weights, graphs, fractions, indices, logarithms, proportion, percentages, interest, approximations, and contracted methods. Part ii., which is chiefly geometrical, includes elementary plane geometry, orthographic projection and descriptive geometry, and some mensuration. In both parts the sequence is unusual, and seems somewhat erratic. The book is well supplied with a good variety of examples and exercises.

(9) The preface to this suggestive book is written by Mrs. Boole, who is the originator of the method described in its pages, a system which well deserves the sympathetic consideration of educational reformers. The leading idea is, working on untutored minds, to find "a means of introducing little children to the conception of a connection between organic thought-sequence and the evolution of harmonious form." The means employed is simple embroidery in coloured threads; by following some simple rule "a graceful curve such as he has perhaps never before seen or imagined, grows up under his hands, as if by miracle." One such is the curve of pursuit. The method has been successfully carried out by Mrs. Somervell and others, and has developed into a system of geometrical design which Mrs. Boole unhesitatingly believes "is a working possibility as a means of truly national evocation of creative and organising power." In order to encourage the spread of the system sets of curve-sewing apparatus have been designed, and can be procured at a moderate cost.

THE ZOOLOGIST AND SPORTSMAN IN BRITISH COLUMBIA.

Camp-fires in the Canadian Rockies. By Dr. William T. Hornaday. Pp. xvii+353; illustrated. (London: T. Werner Laurie, 1906.) Price 16s. net.

MOST sporting books leave the distasteful impression that the hunter's main interest in wild animals is that they are something to kill—the bigger the better. But this book shows us a hunter who, though ardent in the chase and glowing with its barbaric excitement and triumphs, has yet a conscience in his slaying, and can, on occasion, find as keen pleasure in stalking without intent to kill, but only to observe and picture. So that while the sporting man will find in the book a sufficient spice of hunting incident and success to stir the savage emotion, the less bloodthirsty reader also will find satisfaction in the moderation of this hunter and in his vivid presentment of the wild life of mountain and forest.

The book is the record of a recreative holiday trip made in the autumn of 1905 by Dr. Hornaday, the Director of the New York Zoological Park, under the guidance of his friend Mr. Phillips, Pennsylvania State Game Commissioner, to a hunter's paradise hidden away among the mountains of the south-eastern part of British Columbia, where, actually, on the first day of their coming, a band of mountain-goats stampeded through their very camp, almost upsetting the cook at his work!

Here, and at a later camp, with the tangled forests below them and the stony peaks above, they spent their thirty days in great content, readily securing the few picked specimens of mountain-goat and sheep for which they had come; having also the additional luck to add a grizzly bear apiece to their trophies; and thereafter enjoying splendid though somewhat hazardous sport in striving, with success, to "break record" in photographing their live game at close and still closer quarters among the precipices. Of these days in the "home of the mountain-goat" two only were given to hunting goats to shoot them.

"We saw two hundred and thirty-nine individuals. . . . It was because we shot little that we saw much."

Here is a charming picture of the kind of thing they saw:—

"Rising into view out of a little depression on the farther side of the meadow, lazily sauntering along, there came ten big, snow-white billy goats! . .

The air was clear; the sun was shining brightly, the meadow was like dark olive-brown plush,—and how grandly those big pure-white creatures did loom up! . . . For more than an hour we lay flat on our pinnacle, and watched those goats. . . . They were more than deliberate; they were almost stagnant. . . . They were already so well fed that they merely minced at the green things around them. . . . Each one seemed steeped and sodden in laziness. When out grazing, our giant tortoises move faster than they did on that lazy afternoon. When the leader of this band of weary Willies reached the geographical centre of the sky-meadow, about two hundred yards from us, he decided to take a sun-bath, on the most luxurious basis possible to him. Slowly he focussed his mind upon a level bench of earth, about four feet wide. It contained an old goat-bed, of loose earth, and upon this he lay down, with his back uphill. . . . Five minutes later, a little higher up the slope, another goat did the same thing; and eventually two or three others laid down. One, however, deliberately sat down on his haunches, dog-fashion, with his back uphill. For fully a quarter of an hour he sat there in profile, slowly turning his head from side to side, and gazing at the scenery while the wind blew through his whiskers" (pp. 82–4).

Mr. Phillips's photographs of the mountain-goat at close quarters, obtained at such desperate hazard, are admirable; but, after all, he cannot give us that touch of mountain breeze through the lazy Billy's whiskers! And what a pity that such a restful holiday-picture should be spoilt by the crack of a rifle!

Dr. Hornaday's first care in this volume is for the mountain-goat (he scorns the term "antelope-goat" as being affected and incorrect), and next for the mountain sheep and the grizzly bear; but he finds room also for the small neighbours of the big game—the wolverine, pine marten, coyote, pika, ground-squirrel, pack-rat, and others—all depicted with the same sympathetic and vivid touch, and generally with authoritative notes upon their geographic range and novel observations on their habits; and the birds of the region, too, receive a share of his careful notice.

The author deplores the practical extinction of wild life in the Western States, and calls upon the Canadian authorities to do what his own Government has failed to do—stringently to preserve the remnants. He considers that the British Columbian game laws err in being too liberal in every particular, and pleads for the absolute protection of all female game animals and for a reduction of the number of head allowed under each shooting license. Even the grizzly bear should, in his opinion, be protected; and he thinks that, with proper care, the Canadian Rockies might continue almost indefinitely to be the Delectable Mountains of the vigorous sportsman. The attempts that are being made toward this end should be of interest to the student of sociology, who may here watch the development of game laws anew in a democratic community.

To the splendid photographs with which the book is illustrated, and to the sensational circumstances in which some of them were obtained, we have already referred. Both astonishing and amusing is the account given by Mr. Phillips of how, during one of these operations, while on a dangerous rock-ledge from which he could not retreat, he was charged by an angry goat:—

"There was really nothing that I could do except to hold the [stereoscopic] camera at him and snap it. He charged up to within a yard of me, but with his eyes fixed on the two lenses. Then he appeared to conclude that any animal that could stand that much without winking was too much for him, so shaking his head and gritting his teeth he stopped, and to my great relief slowly backed into his niche" (p. 190).

No wonder that the resultant photograph is a "record"!

That the trip was one that any zoologist must have enjoyed goes without saying, and we thank Dr. Hornaday heartily for this delightfully-written record of his own pleasure in it. Indeed, perhaps the chief charm of the book is that he manages so faithfully to convey a sense of the recrudescence of boyish energy and spirits in staid middle-life, aroused under the stimulus of unusual and invigorating surroundings; for is not the enthusiasm of middle-life more contagious than that of youth itself? So let us all echo, for him, his own farewell wish:—

"May heaven keep my memory of it all as fresh as the breezes that blow on Goat Pass, as green as the pines and spruces that clothe the lower slopes of those delectable mountains"! G. W. L.

A BOOK ON CLAYS.

Clays, their Occurrence, Properties, and Uses, with Especial Reference to those of the United States. By Dr. Heinrich Ries. Pp. xvi+490. Illustrated. (New York: Wiley and Sons; London: Chapman and Hall, Ltd., 1906.) Price 21*s.* net.

"DOUBTLESS few people realise the importance of the clay-working industry in the United States, and yet this is not so surprising since clay has less popular attraction than many other mineral products, such as gold, silver, &c. A casual glance, however, at the annual figures of production will probably speedily convince one that clay is to be classed among the foremost products of the country, being outranked only by coal and iron."

In 1904 the value of the clay products of the United States was 26,204,650*l.*, while the raw clay, mined and sold within the States, amounted to 464,030*l.* Not so long ago America was more backward than Europe in the attention she paid to her clay resources. This has now been changed. In recent years we have witnessed the growth of a goodly crop of literature upon this subject in the United States, both in official publications and in occasional papers. The crop has been a heavy one in more senses than one, and bulky withal, and few there are, even in America, whose shelves could afford it space. It should be therefore a matter for congratulation to all American clay-workers that for the sum of five dollars they may now obtain in convenient form—the selected fruit—that which they had already received gratis in great volume. Although the possessors of the numerous

State Reports will be familiar with the style and most of the matter of this book, it is an undoubted advantage to have the information within reasonable compass.

But Dr. Ries has not merely produced a condensed epitome of earlier publications; he has prepared a well-balanced, thoroughly practical work on American clays and clay-products, including a capital summary of our knowledge of the properties of clays in general. The whole has been brought well up to date.

The author treats his subject under the following heads:—(1) The origin of clay, (2) chemical properties, (3) physical properties, (4) kinds of clay, (5) methods of mining and manufacture, (6) distribution of clay in the United States, (7) Fuller's earth.

The distribution of the clays is considered under each State separately, according to the geological age of the formations; but an excellent index enables references to particular kinds of clay to be found readily.

It may be remarked that we are still in the dark as to the cause of plasticity in clays, in spite of the numerous theories; nor has any generally applicable method of measuring this property been discovered. Dr. Ries discusses the subject with great fairness. We heartily commend his views upon the loose way in which kaolin and kaolinite are so often confused, and especially his objection to the assumption that kaolinite is the normal basis of *all* clays; a brief comparison of analyses at once dispels this idea.

This book is very well produced and free from slips, but we are somewhat puzzled by the "increase in texture" mentioned on p. 107.

THE ÆTIOLOGY OF LEPROSY.

On Leprosy and Fish Eating. A Statement of Facts and Explanations. By Jonathan Hutchinson. F.R.C.S., F.R.S. Pp. xxiv+420. (London: Archibald Constable and Co., Ltd., 1906.) Price 12*s.* 6*d.* net.

THE object of this work is stated in the preface to be "to carry conviction to the reader that the fundamental cause of the malady known as true leprosy is the eating of fish in a state of commencing decomposition." The various districts in which leprosy occurs have been examined, and it is found that in practically all fish is consumed as an article of diet, often in a more or less stale condition, the prevalence of the disease frequently being in a direct ratio to the amount of fish eaten. Mr. Hutchinson would associate the former prevalence of leprosy in the British Isles and in Europe with the Roman Catholic ordinances prescribing fish-food on two out of every three week-days, its decline in these countries with the relaxation of discipline which preceded the Reformation, its extinction with the establishment of Protestantism.

We think that Mr. Hutchinson goes much too far in thus ascribing *all* variations in the prevalence of leprosy as being correlated with those of a fish-diet; even in the fact that the disease is more prevalent among men than among women he sees support for his hypothesis, for he suggests that women are more fastidious feeders than men, that men would be more likely than women to obtain fish if this were expensive, and so on. Why fish fresh or properly salted does not convey the disease and only bad fish does is by no means clear, the single suggestion given being that there may be some connection between tuberculosis and leprosy, and that fish-diet may contain some constituent which may modify the tubercle bacillus and convert it into the leprosy bacillus! Mr. Hutchinson maintains that the facts he has collected point to the conclusion that the efficient cause of leprosy must be some article of food (p. 33), and that fish is the only one of universal occurrence which can be traced.

But is it necessary to find a *single* mode of origin for the disease in every part of the world? Surely not, and if so there is no need to limit it to fish. Mr. Hutchinson admits that personal contact may convey the disease, but declares that this mode of infection is exceedingly rare, "where one had acquired the disease, hundreds equally exposed to risk had escaped" (p. viii). But the latter statement proves little; all of us who live in big towns must daily come in contact with the virus of tuberculosis, yet only an unfortunate few contract the disease. Similarly, as regards the decline of leprosy, most, if not all, infective diseases show periods of epidemic prevalence and of decline; to what can be ascribed the disappearance of plague and of malaria from England? Mr. Hutchinson says the world-wide distribution of leprosy proves that "it is not solely dependent upon contagion"; this does not appear to mean personal contact, but to suggest an origin *de novo*. Would not the same apply almost equally to tuberculosis, but would it be said that therefore the last-named disease is capable of "independent origination"? In the case of tuberculosis, often many years may in all probability intervene between infection and manifestation; in leprosy we do not know how long the virus may lie latent, and therefore an exposure long forgotten may really be the determining cause of the attack, without bringing in a *de novo* origin, in those rare cases in which it has not been possible to trace the source of infection.

Lesions of the nasal mucous membrane are extremely frequent in lepers, and the nasal discharge may therefore be the chief vehicle by which the virus is disseminated. It has also recently been reported that the mosquito and the bed-bug may harbour the bacillus, further channels again by which infection may be carried. These, together with the close contact and promiscuous intercourse which exist between the members of native races, seem to us sufficient to explain the source of infection in leprosy, fish-diet being only a remarkable coincidence.

In thus criticising Mr. Hutchinson's theory we do not in the least desire to belittle his work, which is of the greatest interest, and his book is a valuable contribution to the epidemiology of leprosy.

OUR BOOK SHELF.

The Elements of the Science of Nutrition. By Prof. Graham Lusk. Pp. 326. (Philadelphia and London: W. B. Saunders Co., 1906.) Price 12*s.* net.

PROF. GRAHAM LUSK is to be congratulated on having produced a very interesting and important book. The author is an investigator imbued with the true scientific spirit, and his work has always been characterised by thoroughness and sincerity. The introductory chapter is a very lucid exposition, not only of the history of research on the subject of metabolism or nutrition, but it also gives an excellent summary of the nature of the problems to be attacked, and the main results hitherto obtained. This chapter alone entitles the book to high distinction, but the subsequent chapters which fill in the details of the picture maintain the high standard of the beginning. The reader will find here a mine of useful information, and will easily comprehend the facts in their relation to each other, so clearly and exhaustively are they dealt with.

The English reader will be able to study for the first time in his own language the epoch-making work of Rubner, who has, among other points, directed attention to what he terms the specific dynamic value of the foodstuffs; fat outside the body is the most readily combustible of the proximate principles of food, and weight for weight yields more than twice the number of calories which proteids give rise to. Fat has, of course, the same calorific value when it undergoes combustion within the body, but it is inferior to the proteins as a heat generator, because it is burnt with so great difficulty there. The proteins are the most readily burnt of all the foodstuffs, and this property of stimulating metabolism constitutes their specific dynamic value. In the discussion now in progress on the amount of protein food which is necessary, a question raised by the recent work of Chittenden and his colleagues, this factor is one which must not be lost sight of.

The book not only deals with metabolism in health, but also in diseased conditions (gout, diabetes, phosphorus poisoning, fever, &c.) This makes the work very comprehensive, for it is just in these questions of nutrition that physiologists and pathologists may mutually learn so much by a correlation of their respective spheres of study. In the chapter on diabetes, one notes the following sentences:—

"No disease has been more thoroughly investigated. In presenting the details to the reader, it may be remarked that the work done is prophetic of possible accomplishment along scientific lines in the study of disease. It is typical of that scientific medicine which affrights the devoted spirits of a passing empiricism."

Prof. Lusk evidently speaks with feeling, and has perhaps suffered from the passive resistance of the conservative "devoted spirits" to whom he alludes. If anything will move them, it will be study of such books as the one we are dealing with.

The book is very appropriately dedicated to Carl von Voit, the pioneer of such work, and the author's old master. W. D. H.

Physical Chemistry for Electrical Engineers. By J. Livingston R. Morgan. Pp. viii+230. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1906.) Price 6*s.* 6*d.* net.

THIS book has been written not only for the professional electrical engineer, but also for the use of those who desire to obtain a knowledge of physical chemistry sufficient in its scope for the understanding of current work in electrochemistry. The subject-matter is divided into seven chapters, which treat respectively of fundamental principles, the general properties of gases, heat and its transformation into other forms of energy, solutions, chemical mechanics, equilibrium in electrolytes and electrochemistry. An eighth chapter is devoted to a series of problems.

In the method of presentation the standpoint of the now fashionable cult of "anti-atomists" has been adopted, the author's opinion being "that by placing the subject upon a purely experimental basis, giving a practical experimental definition of each concept as it is used and drawing no inference not justified in all its parts by actual results, the reader's idea will be the more clear and scientific." This is distinctly unfortunate, for nothing is gained by the non-recognition of the atomic and molecular hypotheses. The services rendered by the hypothetical atom are too enormous for the concept to be discarded on purely pedantic grounds. Apart from this, the detailed treatment of the subject-matter is good, and the chemical student will find the book interesting reading. It is scarcely to be expected, however, that its contents will be understood by the professional electrical engineer. No doubt a knowledge of physical chemistry is essential for the engineer who would understand the working of storage batteries and the recent developments in electrochemical industry, but when the training of the electrical engineer in this country is considered, the possession of the chemical knowledge requisite for an intelligent reading of Prof. Morgan's book is scarcely to be expected. H. M. D.

The Technical College Set of Mathematical Instruments. No. 727. (London: W. H. Harling.) Price 2*l.* 2*s.*

THERE is great diversity of opinion as to the most suitable case of drawing instruments for students, many colleges having their own particular specifications; but it would be difficult to find a more desirable set of instruments than this of Mr. Harling, on account both of the judgment displayed in the choice of the instruments and the design and workmanship exhibited. In the neat pocket case will be found a 4-inch bow compass, with pen and pencil fittings and lengthening bar; a 5-inch hair divided; three spring bows; two drawing pens; a pricker; keys, spare leads, and needles. The instruments are of the best English design and finish, with knee joints and nut and bolt needle points where necessary.

A student who possesses this case of instruments is so far well equipped for his work in drawing and graphics, and gets exceedingly good value. The instruments can be highly recommended as being entirely suited to their purpose.

A Second German Course for Science Students. By Prof. H. G. Fiedler and F. E. Sandbach. Pp. vii+76. (London: A. Moring, Ltd., 1906.) Price 2*s.* 6*d.* net.

IN a former volume, favourably noticed in NATURE of May 24, 1906 (vol. lxxiv., p. 78), the authors described a series of simple lessons in science suitable for reading by elementary students of the German language. The present volume contains extracts from recent German scientific publications—books, periodicals, and proceedings of societies—of a more technical character, but arranged, so far as possible, in order of difficulty. Some notes on unusual words and phrases, hints on the use of a dictionary, a grammatical summary, and a list of abbreviations provide all the assistance the reader is likely to require at this stage. The extracts have been carefully selected, and will be read with interest and profit by students of physics and chemistry who have a slight knowledge of German.

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.*]

One Vote, One Value.

A CERTAIN class of problems do not as yet appear to be solved according to scientific rules, though they are of much importance and of frequent recurrence. Two examples will suffice. (1) A jury has to assess damages. (2) The council of a society has to fix on a sum of money, suitable for some particular purpose. Each voter, whether of the jury or of the council, has equal authority with each of his colleagues. How can the right conclusion be reached, considering that there may be as many different estimates as there are members? That conclusion is clearly *not* the *average* of all the estimates, which would give a voting power to "cranks" in proportion to their crankiness. One absurdly large or small estimate would leave a greater impress on the result than one of reasonable amount, and the more an estimate diverges from the bulk of the rest, the more influence would it exert. I wish to point out that the estimate to which least objection can be raised is the *middlemost* estimate, the number of votes that it is too high being exactly balanced by the number of votes that it is too low. Every other estimate is condemned by a majority of voters as being either too high or too low, the middlemost alone escaping this condemnation. The number of voters may be odd or even. If odd, there is one middlemost value; thus in 11 votes the middlemost is the 6th; in 99 votes the middlemost is the 50th. If the number of voters be even, there are two middlemost values, the mean of which must be taken; thus in 12 votes the middlemost lies between the 6th and the 7th; in 100 votes between the 50th and the 51st. Generally, in $2n-1$ votes the middlemost is the nth; in $2n$ votes it lies between the nth and the $(n+1)$th.

I suggest that the process for a jury on their retirement should be (1) to discuss and interchange views; (2) for each juryman to write his own independent estimate on a separate slip of paper; (3) for the foreman to arrange the slips in the order of the values written on them; (4) to take the average of the 6th and 7th as the verdict, which might be finally approved as a substantive proposition. Similarly as regards the resolutions of councils, having regard to the above $(2n-1)$ and $2n$ remarks.

FRANCIS GALTON.

A New Volcanic Island.

THE officer in charge of the Marine Survey of India, Commander W. G. Beauchamp, R.I.M., has forwarded the following description of Volcano Island derived from an examination made about sixteen days after its appearance above water. The island is situated off the coast of Arakan, in the Bay of Bengal, about nine miles to the north-westward of Chebuda Island, and has a greatest length of 307 yards in a S.S.W. and N.N.E. direction, and a greatest breadth of 217 yards in a N.W. and S.E. direction; the summit is 19 feet above high water.

Except close to the shore, the soundings in the neighbourhood appear to be unaltered, including the shoal to the N.N.W. which was touched on one line of soundings. The ship approached the island from the north-eastward, and left in an E.S.E. direction. A steam cutter left to the southward for ten miles and returned from S.S.E., and on neither course was any discrepancy in the chart discovered.

The island is still in an active condition at the northern end, several hot springs of liquid mud overflowing. It is steeper on the western side.

Temperatures (Fahrenheit) were taken at different parts of the island, the surface registering 81°, being the same as the atmosphere; at 2 feet below the surface 96°, 3 feet below surface 104°. But at the observation spot on the summit, and evidently the main crater, the temperature at 1 foot below the surface was 104°, at 2 feet below 108°, at 3 feet below 138°, and at 3½ feet the thermometer rose to 148°. No self-registering thermometer was available to take the temperature of the liquid mud. The ordinary thermometer could not be cleaned quickly enough to get an accurate reading.

The island is evidently becoming hard, but the action of the sea and tide is washing it away considerably at present, leaving a wake of discoloured water, giving the appearance of a shoal spit. The Admiralty charts show that several mud volcanoes exist in the neighbourhood.

Drift-wood, sand, and stones were found, although the island was only fifteen or sixteen days old. Fourteen kinds of seed were collected by the surgeon naturalist, from whose geological report it appears that the island is composed wholly of greyish-brown mud of uniform quality throughout; with this are a few angular fragments of rocks of various kinds intermingled. These must have been thrown up with the mud; they include:—(*a*) portions of a laminated sandstone; (*b*) a compact grey rock which has the appearance of a limestone, but which is only partially soluble in strong acids; (*c*) lumps of crystalline calcite; (*d*) a soft green stone, probably a basic igneous rock.

On December 31, 1906, the surface was sun-dried and hardened, so as readily to support the weight of a man. The dried surface is very uneven throughout; it has a nodular and bubbly appearance; besides this, it is split up by deep fissures, due to shrinkage in drying.

On the north side of the island are several small vents. Three of these open into round pools of liquid mud, to the surface of which large bubbles of gas are continually rising. This gas is non-inflammable, and does not support combustion; it has an objectionable sulphurous smell.

In regard to the permanence of this island, considering the nature of the material of which it is composed it is likely that heavy rains and sea action in the south-west monsoon will cause rapid disintegration and total disappearance, always provided that no more material is erupted.

The following case may be quoted from Lyell's "Principles of Geology," vol. ii.:—In 1811 the Isle of Sabrina was formed off the Azores by submarine volcanic action. This, although 300 feet high, "was soon washed away by the waves."

A. MOSTYN FIELD.

Hydrographic Department, Admiralty, London, S.W.

The Forest-pig of Central Africa.

As will be remembered, the singular and interesting forest-pig, *Hylochoerus meinertzhageni*, which appears to be an intermediate link between the true Sus and the aberrant Phacochœrus was first mentioned and named by my friend Mr. Oldfield Thomas in these pages (NATURE, vol. lxx., p. 577, 1904). I believe, therefore, that some further information which widens considerably its range may prove of interest to readers of NATURE.

The type of this remarkable pig is the cranium of a nearly adult male from the Nandi country (E.N.E. of the Victoria Nyanza), sent home by Lieut. R. Meinertzhagen, and now in the British Museum; this, with parts of the skulls of an older male specimen and of a sow, with portions of the skin covered with long black hair of the first, are the materials on which Mr. O. Thomas has described this species (Proc. Zool. Soc. London, 1904, ii., p. 193, pl. xiv., xv.). Since then further materials have been received by the British Museum, also the skull of what appears to be a second species (Proc. Zool. Soc. London, 1906, p. 2).

The Royal Zoological Museum of Florence received a few months ago from Lieut. Ernesto Brissoni, an officer in the service of the Congo Free State, a perfect cranium of a large full-grown male of *H. meinertzhageni*, shot by him at Sendue, on the Upper Congo River, where he was stationed for many months in November, 1904. It is a remarkably big and massive skull, as will be seen by the principal measurements, which, to facilitate comparison, I give in the same order as those taken on the type-specimen by Mr. Thomas; they are in millimetres:—greatest median length, above 425; basal length, 360; zygomatic breadth, 250; nasals, length 260, breadth 70; interorbital breadth, 123; tip to tip of post-orbital processes, 155; intertemporal breadth, 98; breadth across

lateral occipital protuberances, 140; height from basion to top of occipital crest, 137; least breadth maxillary zygomatic process, 70; breadth across sockets of canines, 70; breadth across tips of canines, 290; length of palate, 270; least palatal breadth, between m^2, 40; basal diameter of canine, 40; lower jaw, length, bone only, 325; breadth across symphysis at base of canines, 130; least breadth across diastema, 105; height at diastema, 55; tip to tip of canines, 225; basal diameter, outer face of canines, 22, inner face, 24, posterior face, 16; horizontal length of p^4, 15, of m^1, 19, of m^2, 26·5, of m^3, 45.

Dental formula: $i.\frac{1}{2}c.\frac{1}{1}p.m.\frac{3}{3}m.\frac{3}{3}$.

As I have said, this cranium is massive, the bones rugose on their outer surface, the nasals mostly fused together, and the frontal depression strongly marked.

HENRY H. GIGLIOLI.

Florence, Royal Zoological Museum, February 17.

Gambling and Mathematics.

YOUR reviewer "G. H. B." suggested in NATURE of January 31 (p. 318) that every schoolboy should know something about choice and chance in order that he may not develop into a gambler. I agree with him. But one may suspect that gamblers are either those who have not had the advantages of a mathematical education or those who belong to "slow dull" grade and are unable to appreciate those advantages; and yet one may be quite unable to prove that this is really the case.

Can any of your correspondents bring forward evidence to show that mathematicians gamble less than other men, or that gamblers really are mathematically defective?

The matter is important as indicating the point at which the efforts of an anti-gambling league should be most usefully applied. Is it in the intelligent teaching of mathematics? And are we right in distrusting the methods of exhortation when the methods of algebra will suffice?

Bootham School, York. HUGH RICHARDSON.

THE subject of Mr. Richardson's letter raises a wide field of discussion, of which the few words in my notice convey a very imperfect idea. I should like to see the matter discussed in a suitable quarter when such can be found, but I believe it is a question for psychologists as well as mathematicians.

I take it that the ordinary gambler speculates in order to *win*, and that the prospect of *winning* is the incentive which does the greatest harm.

When a man speculates by staking, say, *1l.* on the chance of winning 100*l.*, the notion of winning 100*l.* makes a big impression on his mind, and means something more real to him than the idea that the odds are 200 to 1 against him (say). He forms a clear mental picture of the prize, and the odds do not present the same picture to his mind. Consequently, he exaggerates his prospects. What I meant to imply is that schoolboys ought to learn to calculate probabilities, so that when they grow up they should think as clearly and form as strong mental pictures of the odds against them in a game of chance as they do of the value of the prizes, and that they should learn to calculate expectations and to think of these rather than of the prizes.

But when Mr. Richardson uses the word "algebra" he implies something different from what I mean, which is more correctly described as arithmetic. What I should like would be to see a chapter on probabilities treated in an elementary course of arithmetic, and boys familiarised with the idea of probability calculations, the representation of probabilities by fractions, and the calculation of expectations, without any algebra being put in to puzzle them. Quite simple questions, in fact. I will not say that everyone who had studied probabilities would not indulge in a game of chance now and then, but they would go in with the expectation of losing rather than winning, and they would know it was no use to try to make up a loss by making false estimates of the probability of the luck turning. If nobody gambled except for the amusement, and if everybody before doing so made a calculation beforehand as to how much they were prepared to pay for that amusement, realising that their expectation in every case was a loss (if playing against a bank), the worst evil of gambling would be eliminated. The only difficulty would be the psychological one of preventing a man from being carried away by his excitement.

What people should know is that to speculate against a bank or syndicate is a bad investment, and that even to speculate where all profits are distributed between players is not a paying investment, but is really also a bad investment even if the expectation equals the man's stake, on the ground that a bird in the hand is worth two in the bush. The loss of the bird in the hand means a definite loss of income; the expectation cannot be regarded as income. G. H. B.

Some New Methods in Meteorology.

SINCE the appearance in NATURE of December 20, 1906, of my review of Prof. Bigelow's "Studies" under the above title, I have had some correspondence with Prof. Willis L. Moore, chief of the U.S. Weather Bureau. I am glad, with Prof. Willis Moore's sanction, to quote part of his letters to me, which will, I hope, allay any apprehensions which may have been aroused as to the methods of research likely to be adopted at the new Mount Weather Observatory. Prof. Moore writes:—"... Since June, 1905, Prof. William J. Humphreys, of Johns Hopkins University, and formerly Professor of Physics at the University of Virginia, has been Supervising Director at our institution at Mt. Weather. We wish to ascertain facts by experimentation, rather than to exploit theories, however beautiful they may be. We consider Prof. Bigelow's numerous papers as expressing simply his own views. ... Neither myself nor any member of my staff desires to be considered responsible for any theories that may be advanced in the publications of the Bureau, except he be the author."

Prof. Willis Moore's explanation, and his recognition of experiment as the necessary and ultimate criterion, justify the expectation that, backed as it is by the resources of the U.S. Weather Bureau, the new research observatory at Mount Weather will prove a most useful institution for the advancement of scientific meteorology.

CHARLES CHREE.

PAGAN RACES OF THE MALAY PENINSULA.[1]

THE scope of this work, which runs to nearly 1600 pages, is defined in the preface, where it is stated to be "essentially a compilation from many sources," but differing from most books of that kind, "first, in being based to a very large extent on materials hitherto unpublished, and accessible only through private channels of information, and secondly in having been constructed with special knowledge of the subject and in a critical spirit."

Accurate though these statements be, they offer but slight indication of how thoroughly the book is inspired with the experience and critical knowledge of the authors, and how well the subjects dealt with have been unified in their hands, a task the difficulty of which may be judged in part by a consideration of the unsatisfactory nature of much that has been written as well as by the length of the bibliography which follows the preface. The authors explain that the several parts of the book dealing with the physical and cultural characteristics of the tribes had been originally arranged under subject headings, and that the book was then re-written upon "a phylogenetic system, so as to throw into relief the differences which separate one race from another," a plan which no one will doubt has added immensely to the clarity of the work. Although the title-page bears the name of both authors, the greater part of the work has been written by Mr. Skeat, Mr. Blagden

1 "Pagan Races of the Malay Peninsula." By W. W. Skeat and C. O. Blagden. Vol. i., pp. xl+724; vol. ii., pp. xi+855. (London: Macmillan and Co., Ltd., 1906.) Price 42*s.* net.

being responsible only for the section dealing with language, although each author has "as far as possible revised and checked the work of the other."

An introduction in which Mr. Skeat sketches with great skill and literary force the environment of the jungle-dwelling folk shows how this has produced characteristic forms of culture, and has compelled the jungle tribes to become perhaps the finest hunters and trappers in Asia. This is succeeded by the first section of the work, that on racial characters; and here, at the very beginning of the work, the reader is faced by its gravest defect; in the whole of the first volume there is no map of the Peninsula, the necessity for which soon becomes manifest and is most urgently felt, *e.g.* on p. 55, where the distribution of the Sakai is given. Indeed, the only map of the Peninsula appears at the end of vol. ii., where it forms part of a small-scale map of Indo-China (about two degrees to the inch), which includes the

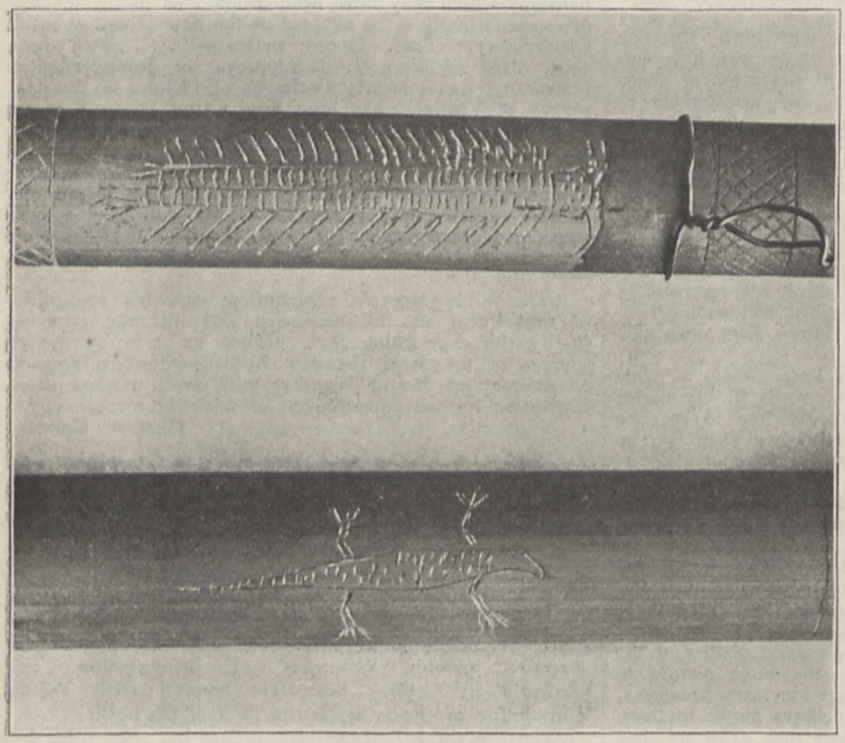


FIG. 1.—Besisi Zoomorphs. Centipede on Besisi flute; Lizard on shaft of Besisi blowpipe. From "Pagan Races of the Malay Peninsula."

Andamans, Sumatra, Cambodia, and part of Siam. But to return to the discussion of racial affinities; Mr. Skeat will have nothing to do with the pan-negrito beliefs of some of the earlier writers, but leaves it doubtful whether he follows Virchow in regarding the Sakai as Dravidian or as related to certain of the wild tribes of the interior of Cambodia, with whose language the Sakai dialects have an admitted affinity. The Jakun are regarded as a composite group of principally aboriginal-Malay tribes, many of which have intermarried freely with Semang and Sakai. It is only necessary to look through the numerous illustrations of individuals or groups, posed so as to show their physical characteristics, contained in these volumes to see how freely the jungle races have in certain instances mixed with each other, and the results of such intermarriage are shown, *e.g.*, in a photograph of a Sakai family the individual members of which, to mention only one physical character, have wavy, curly, and tightly coiled, almost frizzly hair. A number of valuable data bearing upon questions of race are given in tabular form in an appendix; some of these are by Dr. W. L. H. Duckworth, who also contributes a note in the text upon the craniological collection made by Messrs. Annandale and Robinson.

A short *précis* of the distinguishing cultural peculiarities of the jungle people most usefully follows the description of their physical peculiarities. The Semang are the most nomadic, the wilder tribes "never staying it is alleged more than three days in one place"; their habitations consist of natural shelters under overhanging rocks or of the simplest form of leaf shelters. Their national weapon is the bow, with poisoned arrows, though the blow-pipe has been to some extent adopted; they are monogamous, and feel no such fear of the ghosts of their dead as do the Sakai and Jakun. The Sakai, though largely nomadic, are less wild than the Semang, and, unlike the latter, tattoo the face, while body painting has been developed into a regular system. Their weapon is the blow-pipe, with poisoned darts. The Jakun are only partially nomadic, and usually cultivate rice, sugar, or other plants, especially durian trees; they make and use dug-out canoes and the blow-pipe. They have chiefs, who in some cases have regalia, their marriage and burial rites are peculiar, and they have many magic ceremonies and invocations, in other words, their culture is "proto-Malay."

The habitations of these jungle tribes, which are discussed in chapter iii., are particularly intersting. Starting with shallow rock shelters and the buttresses of trees, the series passes through the "primitive beehive" or round hut composed of a number of palm leaves thrust into the ground in a circle, and is continued through the communal shelter (which is originally only an oval "beehive") until a break occurs, and a hut, originally probably a small granary or storehouse on one or more high posts, is reached, which, as the height and stoutness of the posts become reduced, tends to conform with the common Malayan hut type. In this series no mention has been made of tree houses, though Semang and Sakai alike make use of these, which may vary from a few roughly interwoven boughs to veritable houses in trees.

The houses of the less wild Jakun resemble in a general way those of the Malays, but are much smaller than the latter, while the eaves are often carried down to the level of the floor. It is among these people that tribal halls, called balai by both Malay and Jakun, first appear, and Mr. Skeat describes how some Besisi met with on the Selangor coast built a balai at right angles to, and in continuity with, the house of their tribal chief (Batin). Such

balai are mentioned in Besisi songs, and Mr. Skeat holds that their existence is not due to borrowing from the Malays, but is "rather an example of a custom sprung from their common origin."

Closely associated with the character of their dwellings is the form of agriculture of these backward people. A Malay chief of Selangor informed Mr. Skeat that the Besisi were originally in the habit of eating their jungle fruits in temporary shelters built where the fruit trees were most abundant, but that later, recognising that this practice resulted in overcrowding of the fruit trees which sprang from their rejected seeds, these folk took to carrying their fruit to a little distance before eating it, so as to spread the seeds over as wide an area of country as possible. It must be remembered that all these aborigines are adepts at tree-felling, and there seems no doubt that fruit seeds or seedlings of fruit-bearing plants may be planted by the wilder tribes, who do not eat rice or any grain, except when they obtain a small supply by barter. Those Semang who have reached an early stage of agriculture sow a species of millet. Hill rice comes later, but while the folk are still semi-nomadic, and to it is added small catch-crops such as bananas, tapioca, and sweet potatoes, and among the Sakai who have reached this stage of agriculture the preparation of the ground and the sowing and harvesting of the crops are alike accompanied by magic ceremonies and formulæ.

A full description of the weapons and implements at present used provides Mr. Skeat with the opportunity of discussing the origin of the stone adze blades found all over the Malay Peninsula. Unlike the up-country folk of Borneo, who highly value these and hang them in the verandahs of their houses among the skulls they have collected, the Semang and Sakai pay no attention to them, and it seems that these tribes "were not the manufacturers of the stone axes and chisels found in the Peninsula," which may perhaps be attributed to a race described by the jungle folk as once inhabiting their country, though different from themselves and the Malays.

Among all the jungle tribes of the peninsula, the marriage rite consists largely of a form of purchase, usually followed by the ritual sharing and eating of food by bride and bridegroom, but among some Jakun tribes a part of the marriage ceremony consists of a procession or race by the bride and bridegroom around a specially erected mound, while among the Benua of Johor a canoe race, in which the bride is given a considerable start, is substituted.

No less than a hundred pages are devoted to the subject of decorative art, *i.e.* to the art of the Semang and Sakai, described by Mr. Skeat as "by far the most difficult of the many difficult subjects that have had to be faced in compiling the description of these tribes," for it is necessary "to face the fact that with reference to part of this subject an edifice has already been reared upon a foundation of sand, and that though the bricks of which it was composed may to some extent be useful in laying the foundation of the new building, the original edifice is none the less inevitably doomed to irremediable destruction." This, of course, refers to Vaughan-Stevens's flower theory; and in spite of the no less generous than skilful editing and pruning to which the latter's work has been subjected, it is impossible to believe that Mr. Skeat would not have done better to have omitted by far the greater part of his account of Vaughan-Stevens's work, and this notwithstanding the writer's very hearty recognition that no one is so fit as Mr. Skeat to determine the value of Vaughan-Stevens's observations. The feeling that Mr. Skeat's modesty and desire to give the fullest credit to other workers have for once run away with much of his critical faculty becomes stronger as the chapter is studied, and ends in the quite deliberate conviction that it was a mistake to reproduce pages of the patterns on combs copied from the *Zeitschrift für Ethnologie*, while the decorated dart quivers, combs, and boxes collected by Mr. Skeat himself are reproduced on so small a scale that it is impossible in most instances to see the designs at all clearly. Further, although the meaning of some of these is given on p. 419, it is by no means clear to which objects these refer, or whether pp. 416–8 are in fact descriptions, as they appear to be, of the quivers figured in the plate facing p. 414. Very little indeed is known about Jakun art. The two realistic zoomorphs shown in Fig. 1, representing a centipede and a lizard, occur on a Besisi flute and blow-pipe respectively, while two highly conventionalised patterns, said to be derived from the young shoot of plants, are also given.

The difficulty of obtaining information concerning the religious beliefs of these jungle-dwelling tribes was very great; it was only after many conversations with both eastern and western Semang concerning the existence of any supreme being, of whom they long professed entire ignorance, that one of them exclaimed, "Now we will really tell you all we know," and proceeded to tell Mr. Skeat about Ta Pönn, a powerful and benevolent, if otiose, deity, who made the world and who was "like a Malay Raja" in that "there was nobody above him." Although Ta Pönn is obviously identical with Vaughan-Stevens's "Tappern," nothing could be discovered concerning Vaughan-Stevens's superior deities of the Semang called by him Kari and Ple, although Mr. Skeat witnessed a "blood-throwing" ceremony among the eastern Semang resembling that by which, according to Vaughan-Stevens, Ple was appeased. As already stated, the Semang have little fear of ghosts, and their religion shows comparatively few traces of demon-worship and animism. The Sakai beliefs, on the other hand, although admitting a "god" Tuhan (or Peng), who in company with the giantess "Granny Long-breasts" inhabits the upper heavens, are almost entirely animistic, as are those of the Jakun, and for both peoples there are numerous demons to be propitiated.

It is particularly interesting to note that the two savage races of the peninsula that stand furthest apart, namely, the Semang and the Jakun, both have the idea that man at first multiplied so fast as to overcrowd the earth. When this occurred they were slain by the fiery breath of the Thunder Spirit (Semang) or turned into trees by the "high" god Tuhan Di-bawah (Jakun), but in both stories these checks do not suffice, and so death is instituted, and Mr. Skeat again suggests that such common features are mainly due to the "same savage Malay element of which there are such abundant traces in the dialects of both races."

As among Malays, so among these jungle tribes, the accredited intermediary between men and spirits is the medicine man or sorcerer. Among the Semang he is usually the chief, that is to say, the poyang is, by virtue of his office, chief. Among Sakai and Jakun the offices are sometimes separated, though the chief is usually a medicine man of some repute.

In the last part of the work, devoted to the language of the jungle folk, Mr. Blagden points out that most aboriginal dialects have been for some generations in a process of decay, and that Malay is so widely known as to have become the *lingua franca* of the peninsula, so that many of the aboriginals are now bilingual, while others speak

only Malay, more or less modified according to the national idiosyncrasies of the speaker. Moreover, many of the Malayan loan-words are pronounced, not as the Malays of the peninsula pronounce them to-day, but as it would seem they were pronounced when Malay was first written in Arabic characters; thus the *k* still pronounced in Borneo also occurs in the aboriginal dialects. Besides unidentified elements, many constituents of both Semang and Sakai dialects agree with the Mon-Khmer languages, but whether this similarity be due to all these languages being essentially members of one family or to the direct contact of Semang and Sakai with Mon-Khmer peoples is uncertain, though, of course the two views do not necessarily exclude each other. There is a most interesting chapter on tabu language and other special forms of speech, and the work concludes with a comparative vocabulary of the aboriginal dialects which is so arranged as to be particularly easy to use. C. G. S.

ELECTRIC POWER IN LONDON.

UNTIL a couple of years ago the problem of electricity supply in London was mainly one of interest to engineers and investors. Its introduction into the realm of municipal politics, however, has given it a wider interest, and one that tends to obscure the purely scientific aspect of the problem. Alike in connection with water, with gas, and with electricity, London has suffered from the fact of its slow growth and of its being composed of a number of separate towns and districts; its very magnitude, which to-day would enable it to be supplied with electricity more cheaply than any other great city, has been the chief hindrance to its getting such a supply. The enormous number of authorities authorised to supply electricity in Greater London, which at the present time exceeds seventy, has resulted in the establishment of nearly sixty generating stations, many of which are of comparatively small size and inefficient design. The municipal authorities have also been confined to their own boundaries and compelled to choose uneconomical sites, and any attempts at combination between the various authorities which might have enabled them to secure some of the advantages of production on a larger scale have been prevented by the restrictive legislation under which they operate, legislation which was originally passed before the future developments of electricity production were appreciated, while the still more remarkable developments in the uses of electric power were entirely unforeseen. An attempt at concentration was long ago made by the London Electric Supply Corporation, which established its great station at Deptford. That it was not successful was not due to any unsoundness of the principle upon which it was based, but to the fact that it was before its time. Fifteen years afterwards, in 1905, a fresh proposal embodying the first step in the policy of concentration was brought forward by a private company; several of the existing companies at the same time brought forward proposals, not for complete concentration, but for dividing London into three areas, in each of which a supply would be ultimately centralised.

The former scheme, due to its novelty and comprehensive nature, aroused considerable controversy. It was framed on the lines of the various Power Acts which Parliament has passed during the past five years. That is to say, it did not deal with retail supply of *lighting*, but only authorised wholesale supply of electricity and the retail supply of *power* in cases where the Board of Trade thought such supply should be given. Its main object was the establishment of two stations, in which generation would take place on a scale much larger than that of any station in London to-day, and from which electricity would be supplied wholesale to the various distributing authorities by whom it would be retailed to the consumer. The limited right to supply the power consumer direct, in certain cases, was inserted by Parliament in order to ensure that the distributor should not absorb all the advantages of wholesale production.

This scheme naturally aroused much opposition from the existing authorities, both municipal and company. To a large extent, however, this disappeared as the real nature of the Bill became known; in fact, practically all the leading companies, and many of the most business-like local authorities, appreciating the advantages of purchasing a bulk supply in place of having constantly to expend further capital on extending their own smaller generating stations, entered into agreements with the promoters. The manufacturing interests of London also supported the scheme very warmly, and a deputation of leading manufacturers waited upon the Board of Trade, and showed that if the East End could obtain power at the prices fixed by the Bill it would mean an annual saving of nearly 3,000,000*l.* as compared with the present methods of power production. A petition, signed by employers of 100,000 hands, was also presented to Parliament in favour of the scheme.

It was, however, strongly opposed by the London County Council, which, in spite of numerous modifications and safeguards, such as the sliding scale of price and dividend, and the purchase clause, which were inserted in the Bill by Parliament, contended that it was not in the public interest that such a scheme should become law. It, however, passed Committees of both Houses, but so late in the session that it failed to become law.

In the next session of Parliament, 1906, the County Council itself introduced a scheme. The 1905 company's Bill was also re-introduced, and a new scheme was brought forward by the existing companies for linking up their systems and removing the restrictions upon mutual supply to which reference has already been made. The County Council's scheme alone received a second reading, and was sent to a special Hybrid Committee with instructions to consider the whole question.

The County Council's scheme dealt with wholesale supply only; it was strongly criticised by the Council's own Finance Committee, and unanimously rejected by the House of Commons Committee which had been instructed specially to consider it. The Report of that Committee recommended, however, that the Council should be made the controlling authority for electricity supply, but as regards the carrying out of the undertaking suggested that the Council should consider cooperation with private enterprise.

This year the Council has brought forward a more comprehensive scheme, involving nothing less than a monopoly of electricity supply for all purposes over 450 square miles, 330 of which are outside the county. Fourteen of the borough council undertakings are to be compulsorily acquired within five years, the thirteen company undertakings as their concessions lapse. Undertakings outside the county of London are to be acquired by agreement, but until it has secured this monopoly, and to assist in securing it, the Council takes powers to compete (for power supply only) with all these undertakings.

From a scientific point of view the principle of concentration would appear to be correct, but whether electricity supply has reached a state of development when such a big step forward as that proposed by

the Council would be wise is somewhat doubtful. There is no engineering impossibility in wiping out all the existing generating stations with their various systems of supply and in producing the whole of the electricity required for London in a station erected at Barking or Erith, as the Council proposes. But from the financial point of view the magnitude of the scheme appears to be its chief difficulty. Seventeen millions have already been sunk in electricity supply in London, and, according to a careful estimate in a leading financial journal, this sum would have to be nearly doubled before the Council could secure the monopoly at which it aims. Before embarking upon such a scheme, from which when once started there is no turning back, the ratepayers need to be very sure of the future developments of electricity. Three times in the past twenty years have the prime movers used for electrical production been entirely changed. The slow-speed horizontal engines which had been developed during the nineteenth century were first used, and gave place during the 'eighties to high-speed engines of the single-acting or forced-lubricating type for electrical supply. These are now being replaced by steam turbines. Many inventors are, however, at work upon the improvement of large gas engines and other internal-combustion machines, and the attempts which have been made to construct a satisfactory internal-combustion turbine may any day bear fruit.

Now it is obvious that if electricity production in London should become municipalised, so far as London is concerned the rate of development and the adoption of improved methods will be much hindered. Experience has shown that local authorities are, as in fact they should be, very cautious in adopting scientific improvements. This partly arises from a proper regard for the ratepayers' money, but partly from their objection to acknowledge that they have made a mistake and to the consequent criticism of the electorate.

This being so, it would be most unfortunate if anything should be done that would hinder the progress of electrical developments in the metropolis. London is so large that it could certainly afford to get the best in the first instance; the difficulty is to ensure a continuance in the adoption of the most efficient methods when concerns are municipalised. To-day the generating station erected by the Council at Greenwich is practically obsolete as an up-to-date power house.

The problem is one, however, crying for solution. The need for some improvement in London electrical supply is generally admitted, as are the advantages arising from concentration. The best solution of the difficulty is probably that outlined in the report of the Council's Finance Committee issued in December, which closed with the following words:—

"The financial difficulties to which we have called the attention of the Council would to a large extent be obviated if the Council saw its way to adopt some scheme of exercising the powers sought, if and when conferred by Parliament, by which the Council, while retaining general control, would be relieved of the responsibility of working the undertaking in whole or in part."

Whether the solution will be brought about by enlarging the existing stations, as their owners propose, or by erecting new and larger stations on more convenient sites outside, as other experts desire, is a question which must be settled by a Parliamentary Committee and the Board of Trade. But more delay in concentration will be fatal to London's industrial future, and is quite unnecessary if only the Council will realise the need for cooperating with private enterprise, as the Select Committee suggested.

PROF. HENRI MOISSAN.[1]

IT was with deep sorrow that the scientific world learnt of the death of the illustrious French chemist Henri Moissan, which occurred on Wednesday, February 20, following an operation for appendicitis.

Born in Paris on September 28, 1852, Moissan early developed an interest in chemistry, and in 1872 entered the laboratory of Fremy at the Muséum d'Histoire naturelle, attending also the courses of Henri Sainte-Claire Deville, Debray, and others.

This early training firmly fixed the direction of his life's work, for it is precisely along the lines so ably developed by this brilliant school of French chemists that Moissan's genius and resource in experimentation were applied. Worthily to have upheld the traditions and high quality of this school and to have widened the field of inorganic chemistry required powers of no mean order.

From 1873 to 1879 Moissan held the post of assistant in the laboratory of MM. Decaisne and Dehérain at the Muséum d'Histoire naturelle, and in 1874 published, in conjunction with M. Dehérain, his first contribution to science, a study of the absorption of oxygen and emission of carbonic acid by plants kept in a darkened room. In 1877 a series of papers on the oxides of the metals of the iron group was commenced, the whole work being collected and presented in 1880 as a thesis for the degree of *Docteur ès sciences* of the Faculty of Sciences of the Paris University. This research, carried out with much experimental skill and precision, considerably extended our knowledge of the reduction products of the oxides of iron, manganese, nickel, and chromium.

A long connection with the École supérieure de Pharmacie commenced in 1879, by his appointment as demonstrator in chemistry; the chair of toxicology being given him in 1887, after his memorable isolation of fluorine, and finally the professorship of *chimie minérale* in 1899, when his first opportunity occurred for holding a course of lectures on chemistry.

After his graduation, Moissan, from 1879 to 1883, devoted himself chiefly to the study of the compounds of chromium, investigating in particular the chromous salts and perchromic acid. Subsequently, in the laboratory of Debray, and with the active encouragement of Troost and Friedel, he commenced his researches upon fluorine which culminated in 1886 in the isolation of this element.

The difficulties, which had baffled the experimental ability of Humphry Davy, Faraday, Fremy, and many others, were overcome, and fluorine itself was presented to us. That this may justly be considered to be one of the greatest achievements of experimental chemistry in the nineteenth century can be judged not so much by the brilliant result attained as by the display of indomitable pluck and perseverance which assured the successful issue.

After a number of fruitless but well-planned attempts to separate the element from its compounds with silicon, phosphorus, and arsenic, Moissan, on June 28, 1886, communicated to the Academy of Sciences the first details of his experiments on the electrolysis of anhydrous hydrofluoric acid containing potassium bifluoride. The definite proofs of the identity and elementary nature of fluorine were presented in the following month, whilst, on November 8, Debray reported to the academy the complete conviction of the section of chemistry in the validity of the experiments.

From 1886 to 1891 Moissan published numerous

[1] See also the article on Moissan's laboratory and his work in it in NATURE, January 16, 1902, vol. lxv., p. 252.

papers on the chemical and physical properties of fluorine and on many of its compounds, the careful and detailed nature of the investigations being characteristic of all his work.

It is unnecessary to describe further these researches, since the whole subject forms a chapter of their science well known to all chemists, and has, moreover, already been fully dealt with in NATURE (vol. xxxvii., p. 179; vol. xliv., p. 622). Attention should, however, be directed to the fact that in 1897, in conjunction with Sir James Dewar, fluorine was liquefied at the Royal Institution. The construction of an apparatus of copper in 1899, to replace the expensive platinum vessels previously employed, simplified the preparation of the element, and the discovery that dry fluorine exempt from vapours of hydrofluoric acid does not attack glass served in recent years to facilitate the investigation of its properties.

In 1891 Moissan was elected a member of the Academy of Sciences to fill the chair left vacant by the death of Cahours.

The main reason which impelled Moissan to pass from the study of fluorine to the high-temperature researches, which from 1892 onwards absorbed so much of his attention, seems to be closely connected with a desire, which he had long entertained, to solve the mystery of the origin of the diamond. The hope that the great activity of fluorine for other elements would help in the quest not being realised, he was led to a methodical study of the behaviour and transformation of the three allotropic modifications of carbon. This study, which is an excellent example of the logical application of experiment, resulted in the artificial production of diamond, and at the same time added greatly to our knowledge of the peculiar metamorphoses which characterise this element.

The examination of portions of the meteorite from the Cañon Diablo proved the presence of small diamonds, surrounded by thin ribbon-like strips of compressed carbon, hidden in the centre of a mass of iron, and gave him the clue to the solution of the problem. How he planned and successfully carried through the adaptation of this idea in the laboratory with the production of minute but unmistakable diamonds is well known to all. Although this work has been frequently challenged, he had fully upheld the validity of the results, so recently as 1905, by repeating the experiments with still greater precautions, and by applying a more intimate knowledge of the compounds formed under similar conditions. It was for the purpose of augmenting the solubility of carbon in iron that he first required and adopted the electric furnace.

In electric furnace work, Moissan's preeminent position is due, not to the design or discovery of a special form of furnace, but rather to the skill with which he investigated in detail a number of individual chemical reactions. In each case he devoted great care to the purification and analysis of the raw materials required in the process, and submitted the products to minute examination and quantitatively determined their composition. Thus his preparation of chromium, tungsten, molybdenum, uranium, titanium, and many other metals in a fused form and high degree of purity greatly enriched our knowledge of the chemical and physical properties of these elements.

Of still greater importance was the methodical following up of the chance formation of calcium carbide which he observed around the carbon electrodes in his early furnace experiments. From this observation he was led to discover and determine fully the nature and properties of a large number of metallic carbides, borides, and silicides, most of them hitherto absolutely unknown, or, like the metals mentioned already, only obtainable as impure and fragmentary specimens.

There is perhaps no need to consider, at the present time, in how far industry is directly indebted to Moissan's work. He himself had invariably expressed his desire not to be considered in such discussions, and, so far as the merit of his work is concerned, it needs no support of this nature. Indirectly, both science and industry have benefited enormously. On the Continent his scientific investigations are directly credited with a renaissance in the study of inorganic chemistry, which, particularly in Germany, had been almost entirely neglected for the more productive field of organic chemical research. Even in England, which has always held a high position in the pursuit of inorganic chemistry, his work has been of great assistance in instilling enthusiasm and encouraging the deeper study of the subject.

As a teacher, Moissan will be affectionately remembered by all his pupils; even during the tenure of his professorship of toxicology he maintained a research laboratory for chemistry, and attracted to it a number of students, and from the time of his appointment, in 1900, to the chair of inorganic chemistry at the Sorbonne larger numbers were able to avail themselves of his teaching.

As a lecturer, both in his public discourses and in the lectures on inorganic chemistry, which he gave during the last few years of his life, he was distinguished, even amongst French chemists, by the brilliant exposition of his subject and by his skill in experimental demonstration. R. S. HUTTON.

NOTES.

WE regret to see the announcement of the death of Mr. H. C. Russell, C.M.G., F.R.S., Government astronomer of New South Wales.

THE autumn meeting of the Iron and Steel Institute will be held in Vienna on September 23–25, and will be followed by excursions to Bohemia and to Styria.

THE Women's Agricultural and Horticultural International Union is organising an exhibition and sale of farm and garden produce, &c., to be held in the Gardens of the Royal Botanic Society, Regent's Park, N.W., on Wednesday, July 17.

THE Mercers' Company has made a grant of 1000*l*. to the Imperial Institute for scientific research in regard to the economic products of British colonies and protectorates, to be expended under the direction of the managing committee, subject to the control of the Secretary of State for the Colonies.

THE Friday evening discourse at the Royal Institution on March 8 will be delivered by Prof. David James Hamilton, on "Certain Seasonal Diseases in the Sheep and means of preventing them."

ENGLISH geologists who know anything of France and the French Alps will especially regret the death of M. Marcel Bertrand, which took place on February 13. His work on mountain-origins and mountain-structure had an important influence in the development of geological thought. Bertrand succeeded Pasteur as a member of the French Academy of Sciences in 1896.

WE learn from the *Times* that the Royal Academy of Sciences at Stockholm is petitioning the Swedish Government to request the British Government to grant per-

mission for the removal of the remains of Emanuel Swedenborg from the Swedish Church, Princes Square, Ratcliff Highway, to Stockholm in order that they may be re-interred there by the side of the remains of the celebrated chemist, Berzelius.

IN the House of Commons on Tuesday, the Secretary of State for War was asked "whether he was aware that the Army Medical Department and the entire medical profession in this country were mainly dependent on foreign manufacturers for the supply of tubes for X-ray examinations." In reply Mr. Haldane said:—"The X-ray tubes required for military hospitals are purchased from contractors in this country who obtain many of their supplies from Continental manufacturers. The few glass-blowers in this country who make X-ray tubes are unable at the present time to produce tubes in sufficient number to meet the demand or to equal in quality and price those manufactured abroad."

THE Royal Academy of Sciences of Turin has announced the conditions under which the Vallauri prizes will be awarded. One prize of 28,000 francs is offered to the Italian or foreign man of science who, between January 1, 1907, and December 31, 1910, publishes the most important work in the domain of the physical sciences, using the expression in the widest sense.

DR. H. M. BIRDWOOD, whose death on February 21 has been received with regret, followed the example of his brother, Sir George Birdwood, by using his botanical and horticultural interests for the public benefit while officially connected with India. He was the author of a "Catalogue of the Flora of Matheran and Mahableshwar," two of the Bombay hill stations, and was a syndic of the Bombay University.

AN article in the *Times* of February 22 urges that the Explosives Research Committee is culpably responsible for the violent explosion at Woolwich a few weeks ago. The explosion totally annihilated the magazine in which it occurred, wrecked a large number of houses in the vicinity, caused minor damages over a wide area, and produced a shock which was felt thirty miles away. It is said that the research laboratory was improperly used for storing large quantities of dangerous compounds which ought not to have been near a place where experiments with explosives of unknown properties are carried on. A letter signed "Scrutator" in the *Times* of February 12 states that the laboratory contained shells filled with condensed phosphuretted hydrogen and a gasometer full of this gas; and the article on February 22 asks, "what has become of the two kilograms of iodide of nitrogen, the existence of which is common knowledge?" The suggestion that the explosion was due to recklessness and negligence in the research department at Woolwich is damaging to scientific interests, and it is to be hoped that the research board will afford the information required without delay.

THE council of the Society of Arts is prepared to award, under the terms of the Benjamin Shaw trust, a gold medal, or a prize of 20*l*., "for any discovery, invention, or newly-devised method for obviating or materially diminishing any risk to life, limb, or health, incidental to any industrial occupation, and not previously capable of being so obviated or diminished by any known and practically available means." Intending competitors should send in descriptions of their inventions not later than December 31, 1907, to the secretary of the Society of Arts, Adelphi, London, W.C.

ANOTHER of the great teachers who have made Germany famous as a centre of geographical studies has passed away in the person of Dr. Alfred Kirchhoff, who died at Leipzig on February 8 at the age of sixty-nine. Only two years ago Kirchhoff was compelled by failing eyesight, amid universal regret, to resign the professorship of geography at Halle University, where his fruitful and stimulating labours extended over more than thirty years. He wrote various educational works, and only last year supplied, in association with Dr. S. Günther, a valuable treatise on geographical education to Baumeister's "Handbuch der Erziehungs- und Unterrichtslehre für höhere Schulen." His bent lay naturally in the direction of regional geography, which gave full scope to the many-sided character of his knowledge, and perhaps one of his greatest services was as editor (among other important works) of the series entitled "Forschungen zur deutschen Landes- und Volkskunde," which has now reached its sixteenth volume. Some of his studies on the relations between man and his environment attracted wide attention, and were published in a collected volume, which only last year was made available to English readers in Routledge's "Universal Library."

THE Association of Italian Manufacturers has issued particulars of an international competition for prizes to be awarded for the prevention of accidents in factories. Applications must be made before June 30, 1908, to the association, 61 Foro Bonaparte, Milan. The nature and value of the prizes offered are as follow:—(1) A gold medal and 8000 lire (320*l*.) for a system to eliminate the danger of a contact (of whatever resistance) between the primary and secondary circuit of alternate-current transformers and their respective lines. (2) A gold medal and 1000 lire for a hand-crane or winch so constructed that without sensibly reducing the efficiency or speed of lowering, as compared to ordinary types, any danger due to the rotation of the handles by the descending load is avoided. Means must be provided to prevent the rotation of the handles during the descent of the load. With each system competing for the prize an apparatus must be supplied which will enable it to be submitted to practical tests.

ENGLISH geologists lament the death, on February 15, of a well-known amateur, Miss Caroline Birley. Miss Birley was born in Manchester in 1851, and became interested in geological studies at an early age. She travelled extensively in search of fossils and minerals, and made a large collection, which was placed at the disposal of all to whom it could be of use for purposes of research. Her more important fossils were Cretaceous Invertebrata from Faxe, Denmark, Pliocene shells from Bordighera, and Pliocene shells in nodules from the Mekran coast, Baluchistan. Her collection of minerals included some fine zeolites obtained from the Færöe Islands. All the specimens desired by the British Museum are bequeathed to the nation, while the residue of the collection is given to the Manchester Museum. Though herself a diligent and accomplished student, Miss Birley rarely published any notes of her work; but an interesting account of the Chalk section at Faxe from her pen prefaces Dr. Henry Woodward's paper on Faxe fossils in the *Geological Magazine* for November, 1901. Miss Birley attended all the meetings of the British Association from 1887 onwards, and she was also an active member of the Geologists' Association. The president of the Geological Society and the keeper of geology in the British Museum were present among a large circle of friends at her funeral, which took place at Lingfield, Surrey.

A RECENT article distributed by the Decimal Association again directs attention to the advantages to a country of the introduction of the metric system of weights, measures, and coinage. Not the least of these advantages would be the saving of time to business men and workers of all kinds. To children at school the saving of time would be still greater, and this has been estimated with some exactness from figures provided by schoolmasters and others. The association states that the saving in educational time by the exclusive adoption of metric measures would be about 200 hours per child. If coinage also were decimalised, the saving would be increased to about 350 hours. That is, the association says, about 200 million hours a year for ever of school-children's time could be saved by a reform which, it is estimated, would cost adults on the average about the equivalent of a day's work (adding the needed mental exertion to the cost of new weights, metre-sticks, and gauges). The Decimal Association asks for legislation to bring about the improvement advocated; but in the meantime good work is being done, and an increasing amount of attention is paid to teaching children at school the simplicity of the inter-relation of the various metric measures. It is interesting in this connection to notice that one of the earliest Parliamentary Bills on the list this session is Mr. B. S. Straus's Weights and Measures (Metric System) Bill, which is receiving strong support. The Bill proposes that from April 1, 1910, all the present British weights and measures shall be replaced by those of the metric system, and that Parliament shall order the Imperial standards to be altered and issued officially as metric standards. The Bill will make it compulsory that every contract or sale shall be by the new standard kilogram and metre. In order to introduce the new system easily, the Bill arranges that local authorities shall provide local standards at least a year before the Act comes into operation. The metric system is one of the subjects to be discussed at the Colonial Conference to be held in London in April.

AN obituary notice of Colonel Mannheim is contributed by Dr. J. Reveille to the *Revue générale des Sciences* for January 30, and may be read with interest side by side with a similar notice of Lieut.-General De Tilly in the Brussels *Bulletin de la Classe des Sciences*, 1906, p. 10, by M. P. Mansion. Colonel Mannheim, who was professor in the École Polytechnique, devoted his attention, in the first place, to theories of transformation in geometry, and his work is noticeable for the prominence given to metric as opposed to projective methods. Under the title of "kinematical geometry," he developed a large and interesting field of study in connection with the displacements of bodies possessing two degrees of freedom. In this case the trajectory of any point of the system consists, not of a straight line, but of a surface, and the properties of these surfaces were studied by Mannheim up to the third order of infinitesimals. They lead to properties analogous to those relating to focal lines in optics, an application which Mannheim was not tardy in using, and his work also contains interesting applications to the properties of deformable surfaces, theories of contact of the third order, and other problems in infinitesimal geometry. Lieut.-General De Tilly, who for some time was professor, and later director, of the Belgian Military College, was author of a large number of works on geometry and mechanics. At the age of twenty-three he published his "Recherches sur les Éléments de Géométrie," and eight years later he published an essay on the mechanics of non-Euclidean space. He too seems to have been attracted by metric rather than projective geometry, for in his "Essai de Géométrie analytique générale" of 1892, he showed that all geometry ultimately reduced to a single relation between $n+2$ points for space of n dimensions. He also wrote papers on ballistics, and was an authority on educational matters.

OWING to inquiries regarding the cultivation of ramie in Jamaica, information on the subject, extracted from several sources, was reprinted in the December (1906) number of the Bulletin of the Department of Agriculture. Mention is also made of a new decorticating machine, manufactured in Germany by Bœken and Co., of Düren, that is portable and low priced.

IN the first number of this year's volume of the *Kew Bulletin*, Mr. T. A. Sprague discusses the synonymy of the Chilian genus Tricuspidaria, defining two species, and Mr. C. H. Wright furnishes a *clavis* for the identification of the Chinese species of Eriocaulon. Mr. G. Massee contributes an account of the heterœcious uredine fungus, *Calyptospora Goeppertiana*, that grows on species of Vaccinium and transfers to fir trees, constituting a pest more particularly of the silver fir, *Abies pectinata*. A note on ramie respecting the experience of an association for producing the fibre in Tirhut, Bengal, is useful as indicating that there are considerable difficulties in the matter of doing so at a remunerative cost. A list of plants suitable for gardens in the warmer parts of the United Kingdom is supplied in the miscellaneous notes.

AMONG the summaries of recent research contained in *Science Progress*, not any are more useful than those which collate allied facts obtained by workers in different sciences. Prof. J. R. Green contributes an article of this nature on protein hydrolysis to the current number (January), in which he indicates how Cohnheim discovered in animals an enzyme, or more correctly a group of enzymes, that he called erepsin as distinguished from trypsin, while independently Vines had arrived at the conclusion that the so-called trypsin in plants is composed of two enzymes acting at different stages. As to the identity of the proteases in animals and plants, it can only be said that arguments tending in this direction may be adduced. Another botanical summary concerned with recent investigations on the fungi is written by Miss A. Lorrain-Smith, and a note on double fertilisation in plants is communicated by Miss E. N. Thomas.

THE growth in the North Andaman Island of the timber tree *Pterocarpus dalbergioides*, known as *padauk*, is the subject of an article in the *Indian Forester* (December, 1906) by Mr. F. H. Todd. The vegetative formations of the island consist of a belt of mangrove or littoral evergreen forest, above which the *padauk* forest rises to an elevation of 300 feet, when dense evergreen forest takes its place. It is probable that a sheltered aspect is the chief factor regulating the limits of the *padauk* zone. With regard to the rich red colour that characterises the most valuable timber, as it has been observed in trees of large girth and in dead or dying trees the author suggests that probably the colour deepens as the tree approaches maturity or decay. In the same number Sir Dietrich Brandis, referring to the identification of certain spruces growing in Sikkim, Chumbi, and Bhutan, remarks upon the anatomy of the leaves as a distinguishing feature, while leaving the determination to foresters on the spot.

PART i. of vol. xxvii. of the Transactions of the South African Philosophical Society is devoted to the description by Mr. R. Bergh, of Copenhagen, of a collection of South African opisthobranchiate molluscs. Hitherto the known South African representatives of this group have been very few, but Mr. Bergh has been able to describe quite a number of new species, many referable to the genus Aplysia. Owing largely to the influence of currents, there is a marked difference between the marine faunas of the west and east sides of the Cape Peninsula, the latter having a more tropical Indian character. Still, however, typical forms of nudibranchs do occur on the west side. The collection is due to the energy of Dr. Gilchrist, after whom one of the species of Aplysia is named.

WE have received copies of three papers dealing with injurious insects recently issued by the U.S. Department of Agriculture. In the first of these, forming Farmers' Bulletin No. 275, Mr. L. O. Howard discusses the gipsy-moth (*Porthetria dispar*) and the means by which it can best be kept under control. This moth, we may remind our readers, is a European species, accidentally introduced into Massachusetts some forty years ago, since which date it has spread to Rhode Island, and parts of New Hampshire, Connecticut, and Maine. For a long time Massachusetts was left to fight the battle against the invader alone, but the Federal Government has at length recognised its duty of contributing to the expenses of the campaign. Of the other two papers, forming parts i. and vi. of Bulletin No. 63 of the Bureau of Entomology, one is devoted to the hibernation and development of the cotton-boll weevil, and the other to its ally, the strawberry weevil. It has been stated that the best method of destroying the first-named species is by burning or grazing off the cotton stalks in early autumn, so as to reduce by starvation the numbers which hibernate. As a large percentage die during hibernation, this plan is obviously much more efficacious than are attempts at destruction in spring. The strawberry weevil in 1905 inflicted damage on crops in Texas averaging about 12·5 per cent.

OF all the statistical reports annually published in the volume on the mineral resources of the United States, issued by the U.S. Geological Survey, none is of greater interest than that dealing with the production of precious stones; and the report for 1905, an advance copy of which we have received from the author, Dr. George F. Kunz, well maintains the high standard set by preceding reports. It deals not only with the production of precious stones in the United States, but also with the occurrence and production of precious stones in other parts of the world. In the United States the year 1905 was a memorable one, as it marked a record for the importation of precious stones of every variety. The value of diamonds and other precious stones amounted to little short of 7,000,000*l*., while the value of the production of precious stones in the United States was 65,250*l*. The discovery of utahlite, a green variscite (aluminium phosphate), a translucent green stone used as a gem, at a new locality, forty miles south-west of Salt Lake City, promises to furnish a quantity of this peculiarly American stone that may be used in semi-barbaric jewellery. In the mining of tourmaline, beryl, topaz, kunzite, and other stones peculiar to the southern counties of California, some wonderful crystals of rose-coloured beryl implanted on felspar and many fine crystals of red and green tourmaline are found, and in connection with them occur many specimens of great mineralogical interest. The region bids fair to excel that of the Ural, which for more than half a century has led the world in such products. A novel departure has been the cutting of the chrysoprase found at Visalia, California, in its brown matrix, which forms a pleasing contrast to the green colour of the gem. The emerald is still the stone most prized, and at no time has it received so high appreciation in price. Within the last two years there has been immense improvement in lapidary work in the United States in every variety of stone. There has been especial preference for many of the larger stones, and never before have aquamarines, tourmalines, and amethysts been sold in such profusion.

IN the *Bulletin de la Classe des Sciences* (Brussels) M. P. De Heen publishes a photograph, taken in the Place Saint Lambert during a thunderstorm, showing remarkable luminous effects emanating from each of the electric arc lamps at the instant of a flash of lightning. These effects consist partly of bands of light passing from the lamps to the ground, which the author thinks may be caused by conduction currents, but in addition they include two luminous filaments emanating from each lamp, one forming a closed curve and the other curling round at its extremity in the form of a lasso. M. De Heen expresses the opinion that these effects have their seat in the ether, and cannot be accounted for by any corpuscular (or electron) theory of electricity; but whatever may be said on this point, the discharges in question appear to be well worth careful study.

IN the *British Journal of Photography* for February 15 there is an article entitled "British Plates in Germany," in which the writer refers to the great outcry against the increasing imports of English plates into Germany. The reader will gather some idea of this great invasion of British-made plates from the following statistics (in kilos.) which are given:—

1903	1904	1905	1906
9600	23,300	38,700	83,000

The above figures show that, as the writer states, "in open markets the British dry plate has held its own against all comers, and has now shown its capability of disturbing the ranks of manufacturers in a country where home production is favoured and foreign competition handicapped by a tariff." The tremendous increase from the year 1905 to 1906 has been referred to in a German photographic journal as "gefahrvoll für die deutsche Industrie," and German plate makers are now taking a serious view of the situation. The writer tells us that the cry is raised of German-made glass for the German plate maker, because at the present time the latter has to import his glass from Belgium or Great Britain, and "to pay on it pretty nearly as much duty as is paid by the importer of the English plates." A practical illustration of the situation is summed up by the writer, who narrates that when paying a visit to a large German polytechnic, in the instruction rooms he found students being shown the making of positive transparencies on "Thomas's" plates, and of carbon prints on "Autotype" tissue.

THE recent public inquiry at Dunfermline with reference to the death of a miner by an electric shock caused by a haulage rope being made alive, directs attention to the very unsatisfactory state of affairs which still exists in a large proportion of our collieries. It is lamentable that the present calamity and many previous cases were due to the fact that men who have not been technically trained in electrical work are placed in charge of electrical machinery, and although they may be quite practical engineers from

mining and ordinary machinery points of view, are not fitted to examine and overhaul electrical plant. The question arises as to what constitutes a "competent person" within the meaning of the Mines Act (Rule 11), and the sooner this is made quite clear and insisted upon the better it will be for all concerned in electrical mining work. In the present case, the engineer of the colliery and the "overman" were entrusted with the machinery in question, and the evidence proves clearly that they were only expected to see that outside and surface connections were all right, and also to open up switch boxes, but any internal faults and so on were not considered to be within their responsibility. Colliery managers must be made to realise that technically trained men should be employed to undertake electrical work in the colliery, and until they do so accidents are bound to occur—the only wonder being that they are not more frequent.

PROF. R. W. WOOD has sent us a description of a series of interesting experiments he has made in the direction of the optical intensification of paintings. One of the difficulties an artist has to contend with in depicting scenes in which great contrasts of luminosity occur is the narrow range of luminosity obtainable on canvas with pigments. Aubert states that the whitest paper is but fifty-seven times as luminous as the blackest, and this probably represents about the range obtainable in paintings. The problem is, therefore, how to produce a strong illumination on all high lights of the picture and a feeble illumination on all the shadows. Prof. Wood has obtained good results by taking a photograph of the painting on an orthochromatic plate, preferably a red sensitive plate with a suitable ray filter. A lantern-slide is then made from the negative, and the picture projected in a dark room, not on a white screen, but on the original painting. Any desired effect can be secured by local reduction or intensification of the negative or lantern-slide. If the negative itself is projected upon the painting a most curious effect is obtained. The contrast is lessened, and if the negative is a dense one the contrast may be almost destroyed, making the painting appear a flat wash of chocolate. In taking the negative, care must be taken to have the painting vertical and the camera lens directly in front of the centre of the picture. If after looking for a few minutes at a painting illuminated in the way described the lantern-slide is removed and a uniform illumination allowed to fall on the picture, it appears as if it had not been dusted for ten years; the sunlight leaves it, and everything looks flat. Prof. Wood finds that the effects are very different according to whether the negative is taken on an ordinary or an orthochromatic plate, especially if there is much blue in the painting. He thinks, too, that if the values are correct in the original painting, they will hold under the graded illumination produced by the lantern-slide; if they are not right, the errors will be glaringly magnified.

No. 95 of the Communications from the Physical Laboratory of the University of Leyden contains an account of a series of investigations on the measurement of very low temperatures carried out under the superintendence of Dr. Kamerlingh Onnes, the director of the laboratory. Mr. C. A. Crommelin has compared the readings obtained by a thermoelement of constantin-steel with those given by the hydrogen thermometer. Mr. J. Clay has measured the coefficient of expansion of Jena glass and of platinum between $+16°$ C. and $-182°$ C., and compared the platinum resistance thermometer with the hydrogen and the gold resistance thermometer, whilst M. C. Braak has made a detailed investigation of the hydrogen thermometer as a means of measuring low temperatures.

THE transformation, which was first observed by Lallemand in 1870, of orthorhombic sulphur, dissolved in carbon disulphide, into a less soluble amorphous variety under the influence of light, forms the subject of a paper by Mr. G. A. Rankin in the *Journal of Physical Chemistry* (vol. xi., No. 1). The transformation is brought about by the violet and ultra-violet rays, and is reversible, the conversion of the amorphous form into the orthorhombic crystalline variety taking place when it is kept in darkness. The presence of ammonia or hydrogen sulphide accelerates the latter change and tends to prevent precipitation from a carbon disulphide solution even in bright sunlight. Conditions of equilibrium depending on the intensity of the light can be established between the two forms of sulphur present in solution at a constant temperature.

A SECOND edition of Mr. Mervyn O'Gorman's "Motor Pocket Book" has been published by Messrs. A. Constable and Co., Ltd. The book has been revised and enlarged, and its price is 7*s*. 6*d*. net.

THE writer of the article on the "Treatment of Cancer" in NATURE of December 20, 1906, writes to say that he was in error in believing that the injections of the pancreatic enzymes have to be made in the neighbourhood of the growth (January 10, p. 247). He understands that this is not the case, so an objection he raised to the trypsin treatment is removed.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN MARCH:—

March 1. 11h. 42m. Minimum of Algol (β Persei).
,, 14h. Mercury at greatest elongation, 18° 9′ E.
4. 8h. 31m. Minimum of Algol (β Persei).
6. 22h. 26m. Conjunction of Mars with the moon, Mars 3° 13′ S.
12. Venus. Illuminated portion of disc = 0·639.
16. 3h. Conjunction of Vesta with the moon, Vesta, 0° 7′ N.
21. 6h. Sun enters Aries, Spring commences.
,, 7h. 16m. to 8h. 30m. Moon occults χ^1 Orionis, (mag. 4·7).
,, 12h. 30m. to 13h. 25m. Moon occults χ^4 Orionis, mag. 4·8).
,, 16h. 38m. Conjunction of Jupiter with the moon, Jupiter 2° 32′ N.
24. 10h. 14m. Minimum of Algol (β Persei).
27. 7h. 3m. Minimum of Algol (β Persei).

A NEW FORM OF CŒLOSTAT TELESCOPE.—One of the chief difficulties encountered in the work of the Mount Wilson Solar Observatory has been the deformation and poor definition of the sun's image, caused by the distortion of the mirrors and by the unsteadiness of the heated atmosphere through which the horizontally projected beams have to pass when reflected from the cœlostat to the spectroheliograph or spectrograph.

Prof. Hale now proposes to obviate some of the difficulties by having the whole instrument vertical, and in No. 1, vol. xxv. (January), of the *Astrophysical Journal* he describes and illustrates the form of the proposed instrument. The cœlostat mirror (diameter 17 inches) is to be mounted on a steel tower some 60 feet high in such a manner that it can be moved to follow the sun without disturbing its adjustments. A second mirror, elliptical in form, will again reflect the beam on to a 12-inch object-glass (60 feet focal length) mounted directly below it, and

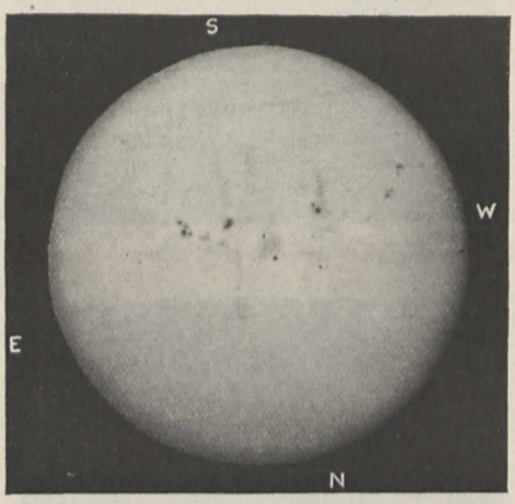
this will focus the image on to the slit of the 30-feet spectroheliograph or that of the Littrow spectrograph; both these instruments will be underground, and will therefore be preserved at a fairly even temperature.

To prevent its distortion, each mirror is to be 12 inches thick, and will be silvered on both sides, and, if necessary, heated on the back by reflected or direct sunlight. An electric motor will drive the photographic plate across the secondary slit of the spectroheliograph, and will by means of a vertical shaft impart a synchronous motion to the 12-inch lens, and hence to the sun's image.

The Littrow spectrograph is to be fitted with an 8-inch plane grating, and will be employed in the study of the solar rotation and in the photography of sun-spot spectra.

THE RECENT LARGE GROUP OF SUN-SPOTS.—Another large group of sun-spots visible to the naked eye—of which the solar maximum through which we have just passed has furnished an abnormal number—was observed during the former half of the present month.

The first signs of this group appeared on February 6, when two small nuclei were seen on the eastern limb about 15° south of the equator, and these were followed by two similar spots on February 8. On February 9 a larger spot brought up the rear of the group, which then contained a large number of small umbræ. In London,



Photograph of sun taken 0h. 47m. February 11, 1907.

bad weather prevented the daily observation of the development of the group, but on February 11 it was easily visible to the naked eye, and was seen to have developed a second fairly large spot at its preceding extremity. The accompanying reproduction is from a photograph taken at 0h. 47m. on that date, and it may be seen that the preceding spot was then the largest in the group, and had a peculiar kidney-like shape. The total affected area was then roughly rectangular, with a length of about 115,000 miles and a breadth of about 55,000 miles. Naked-eye observations of two groups were possible on February 14. The larger group formed a striking spectacle on the western limb on February 18, but had disappeared from view when the sun was observed on the following day.

THE SPECTROSCOPIC BINARY λ ANDROMEDÆ.—From a number of spectrograms of λ Andromedæ, taken with the Mills spectrograph, 1897–8–9, a set of elements for the orbit of the binary has been computed by Mr. Burns, of the Lick Observatory. On comparing these elements with those determined from more recent spectrograms, taken with the re-mounted Mills spectrograph, it is seen that there are material differences which can only be reasonably accounted for by the supposition that the orbit itself has been modified. The discrepancy, if established, will probably be found to be due to a third body in the system of this star (Lick Observatory Bulletin, No. 105).

THE GROWTH OF MICRO-ORGANISMS.[1]

THE author, early in the past year, began to make experiments on the origin-of-life question, with various saline solutions containing ammoniacal salts. After a time he found the best results were to be obtained with one or other of two solutions, one of which contained small quantities of sodium silicate, ammonium phosphate, and dilute phosphoric acid in distilled water, and the other a simple solution of sodium silicate with liquor ferri pernitratis in distilled water. It was found, also, that with the use of these saline solutions exposure of the experimental vessels to diffuse daylight, with even a mean temperature of only 60° F. to 65° F., favoured the appearance of microorganisms quite as much as, or even more than, darkness associated with an incubator temperature of 95° F.

The solutions were placed in previously superheated tubes, which, after being hermetically sealed, were heated again in a calcium chloride bath to 239° F. (115° C.), 248° F., 257° F., or 266° F. (130° C.), for ten to twenty minutes. In all these tubes, after the process of heating, a small deposit, either of silica alone or of silicate of iron, was thrown down. The tubes were subsequently exposed either to diffuse daylight or else in the incubator, and mostly for periods varying from five weeks to four months. When opened, the tubes were found to contain, in varying abundance, one or more kinds of micro-organisms, photographs of which were shown.

One point of much interest in connection with these experiments is the fact that no carbon was ostensibly contained in the solutions, though its close chemical ally, silicon, was always present.

It had previously been determined that such solutions proved excellent nourishing media for the growth of micro-organisms, and this fact led to trials whether any evidence was to be obtained tending to show that such solutions could also actually engender living units. On examination of the contents of the tubes after their prolonged periods of exposure to light or in the incubator, the organisms were always found, after careful search, on or within the substance of the flakes of silica, while the fluid above remained perfectly clear.

Many organic compounds have been discovered by chemists in which silicon wholly or in part replaces carbon, and it is contended that there is good *primâ facie* evidence from these experiments tending to show that silicon is capable of entering into the composition of protoplasm itself—that is, wholly or in part taking the place of carbon.

In regard to the major question, concerning the origin of life itself, the facts to be borne in mind are these:—If a few hours after the heating of the tubes one or more of them be opened as "control" experiments and the sediment carefully examined, no organisms of any kind are to be found, but, after suitable periods of exposure, organisms may be found, in more or less abundance, in the sediment taken from other similar tubes. Here, then, is evidence that *the organisms are living*; they have appeared and multiplied within sealed tubes, though at earlier dates none is to be found.

Then again, it is important to bear in mind (1) that, apart from "spores" of bacilli, no micro-organisms can resist an exposure of two or three minutes in boiling water, this being lethal for bacteria, vibriones, micrococci, torulæ, and moulds; and (2) that all ordinary spores of bacilli are killed by a similar exposure for a minute or two to 115° C. (239° F.).

It is concluded, therefore, that the bacteria, bacilli, vibriones, micrococci, torulæ, and moulds which have been taken from hermetically-sealed tubes previously heated to 115° C., 120° C., 125° C., and 130° C. for ten to twenty minutes must have been engendered *de novo* within these vessels.

The organisms that arise *de novo* are presumed by the author to assume well-known forms, for precisely the same reason that the various representatives of the crystalline world, *when they originate*, invariably fall into their own specific shapes, and with surfaces always inclined to one

[1] "On the de-novo Origin of Bacteria, Bacilli, Vibriones, Micrococci, Torulæ and Moulds in certain previously superheated Saline Solutions contained within hermetically sealed Tubes." By Dr. H. Charlton Bastian, F.R.S. Read before the Royal Medical and Chirurgical Society on January 22.

another at angles that never vary for each particular species of crystal. The forms in each set of cases—in organisms and in crystals alike—may be regarded as the necessary resultants of the molecular constitution of their initial units in the particular media and surroundings in which they occur.

PROPERTIES OF ALLOYS.[1]

THE research described in the report was carried out by the authors with the cooperation of the Broughton Copper Co., Manchester, and the British Aluminium Co., Milton, who furnished respectively the best *commercial* copper and aluminium for making the alloys, undertook the rolling and drawing of the materials, and made special castings where necessary.

The salient points of the report are stated as follows :—

(*a*) The number of alloys that have been found of any industrial and technical promise is small. Such alloys are chiefly those very rich in copper. At this end of the series the limit of serviceable alloys must be placed at 11 per cent. At the other end of the series the limit is even smaller. Among the specifically light alloys rich in aluminium the limit is probably not higher than 4 per cent. of copper. Between 11 per cent. and 96 per cent. of aluminium (exclusive) the alloys do not appear to be of any practical promise.

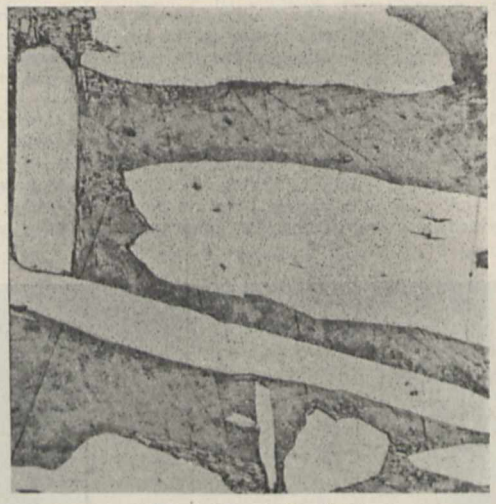
(*b*) But if the range of serviceable alloys is narrow, their quality is certainly high in several instances. This statement holds for certain of the rich copper alloys containing between 7 per cent. and 10 per cent. of aluminium. It is not going too far to say that in certain respects the best of them equal, and even surpass, high-quality steels of the same general character.

The following summary refers only to the rich copper alloys :—

(*c*) Four features of the results of the tensile stress tests of outstanding interest merit a special comment.

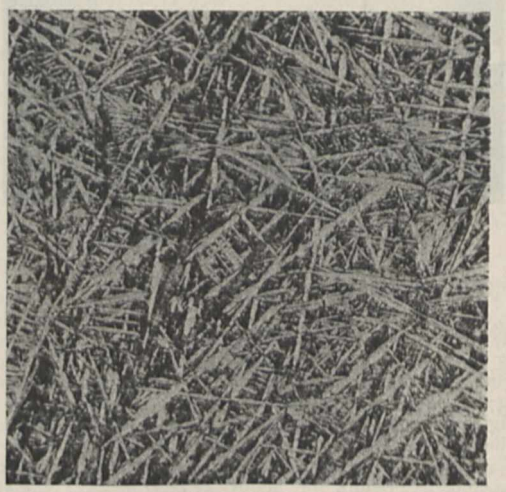
(1) In view of the doubt which exists at the present time as to whether copper and its alloys possess true yield-points, it is important to record that from 0·1 per cent. to 9 per cent. of aluminium the alloys possess clearly marked yield-points.

Rolled.



After prolonged annealing.

After a short annealing.



Quenched from 900° C. in water.

Structures of an alloy containing { 90·06 per cent. of copper. 9·90 ,, aluminium.
Magnification 150 diameters.

[1] Abstract of the Eighth Report to the Alloys Research Committee : On the Properties of Alloys of Aluminium and Copper. By Prof. H. C. H. Carpenter and Mr. C. A. Edwards, of the National Physical Laboratory. Read at the Institution of Mechanical Engineers on January 18

(2) It has been recently shown by Messrs. Stanton and Bairstow (Proceedings of the Institution of Civil Engineers, 1906) that the primitive yield-point of a rolled or forged steel is usually an artificial figure, and is due to a *stiffening* caused by this mechanical treatment. Such is not the case with these alloys. Their primitive yield-point is the true one.

(3) The ductilities (considered as a product of the percentage elongation and reduction of area) of alloys containing from 0·1 per cent. to 7·35 per cent. of aluminium are very high and practically constant, even although the tenacity increases markedly with rise of aluminium.

(4) The tenacity and ductility of the widely-known "aluminium bronze" or "gold," containing 10 per cent. of aluminium, have been found to be as good in the form of *small chill castings* as in the *rolled bar*, where an 80 per cent. reduction of area of the original ingot has been effected. So far as the authors have been able to learn, this result has no parallel. At their request, therefore, independent tests were instituted at the Broughton Copper Works, and these have confirmed the above result, which may have important practical consequences.

(*d*) The research has brought to light several striking instances of the profound influence of a small quantity of aluminium upon copper, notably in the tension tests, but especially in the torsion and electrical conductivity experiments. One-tenth of 1 per cent. raises the angle of twist of copper in torsion 90 per cent.; it lowers the electrical conductivity 23 per cent.

(*e*) The behaviour in torsional stress of the alloys containing from 0·1 per cent. to 7·35 per cent. of aluminium is one of the outstanding features of the report.

(*f*) The alloys containing from 5 per cent. to 10 per cent. of aluminium have come well out of the dynamic stress tests. The particular merit of alloys Nos. 9 and 13 when tested in alternating stress is the close approximation of the maximum stress under which they will bear an unlimited number of reversals to the stress at the elastic limit as determined in a tensile test. *In this respect they are markedly superior to the iron and steel specimens hitherto investigated.*

Alloys Nos. 6, 9, and 13 stood up well when repeatedly stressed beyond the yield-point in Arnold's test. In fact, Prof. Arnold has informed the authors that "Alloy No. 9 constitutes a record in its capacity of resisting alternations."

(*g*) At about 15 per cent. of aluminium the alloys are entitled to rank with quenched steels in *hardness*. Thus the hardness number of No. 17 (15·38 per cent.) in the *cast* state (untreated) is 539, which is about that of a 0·45 per cent. carbon steel quenched in water at 20° C. (68° F.), and is only slightly lower than that of a 0·66 per cent. carbon steel similarly treated.

(*h*) In the corrosion tests, which were purposely made as severe as possible, alloys containing from 1 per cent. to 10 per cent. of aluminium have shown themselves to be practically incorrodible by sea-water, whether alone or bolted to a plate of mild steel. In these tests they showed themselves superior both to Muntz metal and naval brass, which corroded appreciably. In tap water of medium temporary hardness the positions were exactly reversed.

(*k*) In view of the discussion in the previous report as to the trustworthiness of temperatures measured with a protected thermo-junction, the exact influence of the jacket (a fire-clay tube 1/16th inch in thickness) between temperatures of about 1100° C. and 550° C. (2012° F. and 1022° F.) has been determined. It has been found to cause a lowering of not more than 3° C. (5°·4 F.) at the higher, and 9° C. (16°·2 F.) at the lower temperature, and above 800° C. (1472° F.) comes *within* the experimental errors and uncertainties of the method.

(*l*) Finally, a special comment must be made on the truly extraordinary similarity in physical and mechanical qualities between alloy No. 13, which consists of 90·06 per cent. of copper +9·90 per cent. of aluminium, and Swedish Bessemer rolled steel of about 0·35 per cent. of carbon and thirty-eight tons per square inch ultimate tensile stress.

A PROPOSED INTERNATIONAL ATTACK ON THE SIDEREAL PROBLEM.

IN a brochure[1] written by Prof. J. C. Kapteyn, of the Groningen Astronomical Laboratory, the author outlines the chief points of a very comprehensive attack, which he proposes should be made as soon as possible, on the main problems concerning the structure of the sidereal universe.

Whilst the "Carte du Ciel," parts of which are now approaching completion, gives us the relative projected positions of all the stars down to the eleventh magnitude, and will, by duplication after a number of years, afford material for the accurate determination of proper motions, it leaves untouched the extremely important question as to the distribution of different stellar types in actual space. Prof. Kapteyn proposes to supplement this enormous work by the preparation of a Durchmusterung which shall contain all the necessary data for a preliminary discussion of the structure of the universe. In fact, he proposes that in the same way that the geological has supplemented the geographical study of the earth, so shall an *astrological* supplement our astrographical study of the heavens; but it is obvious that to attempt a scheme like this for the *whole* of the heavens at once would be to court failure. The plan would probably die of senile decay ere it showed sufficient results to have justified its existence. For this reason, and acting on the advice of eminent astronomers who favour the idea of such a survey, Prof. Kapteyn limits his proposals to a number of selected areas of the sky. This would reduce the work immensely, and would probably lead to a first approximation of the truths which it is hoped to educe.

The general scheme is based on the method of "gauging" as carried out by the Herschels, only that now, instead of considering simply the numbers of stars, every ascertainable fact in regard to the objects studied must be considered. The chief data to be obtained, as enumerated by the proposer of the scheme, are visual magnitudes, photographic magnitudes, spectral types, astronomical proper motions, radial velocities, and parallaxes, to which list he adds the determination of the amount of light received from different parts of the sky, as being a subject of great importance to the problem under consideration.

As Prof. Kapteyn points out, there are already sufficient data for the brighter stars, partially excepting parallax and photographic magnitudes, to allow of a fairly thorough statistical treatment, but much of this data needs a great amount of arrangement and classification ere it can be included in a homogeneous attack. The great need in such an inquiry as that proposed is the international study of the *fainter* stars. Work already completed, or now in hand, will take us down to the seventh or eighth magnitude for most of the elements named, but it is self-evident that, in any attempt to solve the riddle of sidereal structure, the Milky Way is an all-important feature, and, therefore, far fainter magnitudes than this must be included.

Put into its briefest form, the scope of Prof. Kapteyn's proposals is:—"For 206 areas regularly distributed over the sky, and for another less extensive series of particularly interesting regions, to obtain astronomical data of every kind for stars down to such faintness as it will be possible to get in a reasonable time." The 206 areas first named come under the designation of "the systematic plan," and are again divided into two classes, the first of which would comprise 118, and the second eighty-eight areas. These are so arranged that the first class might be completed independently of the second, and would furnish sufficient data for a first approximation. Then, if there were evidence that this could be executed in reasonable time, the second class might be intercalated without interfering with the other, except to provide further data which would, in all probability, enhance the value of the final

[1] "Plan of Selected Areas." By Prof. J. C. Kapteyn. (Groninge, 1906.

results to an extent incommensurable with the extra labour involved.

The 206 areas would include 400 square degrees of the sky, and this full scheme would entail the following labours:—The determination of the rough positions and sharply defined photographic magnitudes of some 200,000 stars; visual magnitudes for the same 200,000; the determination of the accurate proper motions, to within $0''.01$ in each coordinate, of some twenty thousand of these objects. For the same twenty thousand, parallaxes are necessary, and for as many of them as is possible the class of spectrum and the radial velocities must be determined. Finally, the determination of the total amount of light received from different parts of the sky would complete a set of homogeneous data from which undreamt-of additions to our knowledge of the sidereal universe might accrue.

In addition to this "systematic plan," Prof. Kapteyn, after much correspondence and discussion with a number of eminent astronomers, has decided on a scheme for the elucidation of "special areas." This scheme includes forty-six areas, such as those in the Milky Way which show intense variations of star-density, the rifts and branches of the Milky Way, and extra-galactic areas where nebulæ or strong contrasts in star-density are preponderant.

Many interesting devices to further the plan are discussed by Prof. Kapteyn, *e.g.* the determination of colour, and hence the probable spectrum class, from the comparison of the photographic and visual magnitudes in the cases where the stars are so faint that these features cannot be determined by the usual methods; again, the determination of proper motions and parallaxes from plates exposed a second time after an interval of some years. Possibly Prof. Wolf's stereo-comparator method of determining proper motions would materially curtail the interval necessary between the two exposures.

Considering a few details, it is seen that the scheme includes:—(1) 9710 exposures on 2620 plates, in addition to the plates for the determination of the radial velocities of three or four standards in each area. (It is intended that the bulk of the radial velocities shall, if possible, be determined by one of the wholesale prismatic-camera methods such as those proposed by Herr Orbinsky, Prof. E. C. Pickering, and Prof. Comstock.) (2) Visual observations of 3024 standard magnitudes, the determination of the magnitudes and positions of 200,000 stars, and the meridian observations of some 2600 stars for proper-motion standards. (3) The measuring of nearly $1\frac{1}{2}$ million images.

Prof. Kapteyn, with all his experience, is quite ready, should the essential funds be forthcoming, to undertake a greater part of the measuring work, and could, at present, undertake to perform half his proposed share. A number of other well-known astronomers, as may be seen from the letters which he publishes at the end of his brochure, are definitely and enthusiastically in favour of the project, and are willing to grant what aid is in their power, so that the scheme cannot be looked upon as immature or as entailing insuperable difficulties.

Accepting for the moment that the plan, in its entirety, is feasible, the *possibilities* attached to the discussion of the results are obviously infinite. In some fifty or a hundred years, the "Carte du Ciel," if repeated, will probably afford a series of definitive proper motions which can then be discussed from the sidereal structure standpoint; but of the spectral layers in the visible universe it would leave us in almost total ignorance. On the other hand, the results from Prof. Kapteyn's plan would probably afford all the information attainable by human effort of the sidereal strata, or groups, or drifts, or a thousand and one other features.

As an earnest of what might accrue from such a discussion, one may cite the remarkable result recently derived by Mr. Eddington from the analysis of the relatively meagre data of the Greenwich-Groombridge proper motions (see NATURE, No. 1938, p. 182, December 20, 1906), a result first derived, in a qualitative form, by Prof. Kapteyn himself from a discussion of the Bradley proper motions.

W. E. ROLSTON.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—At a meeting of members of convocation in Magdalen College on February 23, which had been summoned by the Vice-Chancellor to consider the election of a Chancellor of the University, there seemed to be a majority in favour of the nomination of Lord Curzon.

The published accounts of the common university fund for 1906 show that the income for that year was 6937*l.*, and the expenditure 6395*l.*, of which sum 3577*l.* was devoted to scientific objects.

CAMBRIDGE.—The Smith's prizes have been awarded for the following essays:—"Fluorescence," G. R. Blanco-White; "The Systematic Motions of the Stars," A. S. Eddington; "The Bending of Waves Round a Large Opaque Sphere and some Associated Problems," J. W. Nicholson; "The Variation of the Absorption Bands in the Spectrum of a Crystal under the Action of a Magnetic Field," W. M. Page. The names are arranged in alphabetical order. The essay on "Some Problems on the Diffraction of Electric Waves," by H. J. Priestley, is awarded honourable mention.

H. R. Hassè has been elected to the Isaac Newton studentship, tenable from April 15, 1907, to April 15, 1910. The student will carry on a course of research in physical optics.

W. Spens has been elected fellow at Corpus Christi College, and has also been appointed director of natural science studies in the college.

Dr. Harmer, the superintendent of the Museum of Zoology, announces the receipt of a cast of a skeleton of *Diprotodon australis*, presented by Dr. E. C. Stirling, F.R.S., director of the South Australian Museum at Adelaide. Dr. Harmer also records the gift of a valuable consignment of some nine skeletons and forty skulls and skins of mammals, mostly antelopes, from tropical Africa, presented by Mr. C. B. C. Storey, of Clare College.

The Cavendish Laboratory Extension Syndicate has proposed plans for the new laboratory running along Free School Land, which will cost between 7000*l.* and 8300*l.* Towards defraying the cost of this building there is available Lord Rayleigh's gift of 5000*l.* out of the Nobel prize, and Prof. Thomson is able to find 2000*l.* from the laboratory funds.

The recommendation of the general board of studies that a university lecturer in pathology be appointed, in connection with the special board for medicine, with an annual stipend of 100*l.* payable out of the common university fund, will be brought before the Senate on March 9.

It is proposed to nominate Prof. A. Thomson to be a member of the board of electors to the professorship of anatomy; Sir E. C. Perry, a member of the board of electors to the Downing professorship of medicine; Prof. Graham Kerr, an elector to the professorship of zoology; Dr. Anderson, an elector to the chair of physiology; Prof. Middleton, an elector to the Drapers' professorship of agriculture; and Prof. Langley, to that of botany.

The local examinations and lectures syndicate has appointed E. A. Parkyn and D. H. S. Cranage as delegates at the International Congress on School Hygiene to be held in London in August.

Mr. J. J. Lister has been appointed a manager of the Balfour fund until June, 1909, in succession to the late Sir Michael Foster.

Mr. F. A. Potts has been nominated to occupy the University table at the laboratory of the Marine Biological Association at Plymouth for one month during the ensuing Easter vacation.

THE Mercers' Company has made a donation of fifty guineas, and the Grocers' Company one of ten guineas, to the South-Eastern Agricultural College.

AT the South-Western Polytechnic on March 15 the Lord Alverstone, G.C.M.G., Lord Chief Justice of England, will present prizes and certificates to students of evening classes and of the day college.

THE Goldsmiths' Company has undertaken to provide the 8000*l.* required for the completion of the new wing of Goldsmiths' College at New Cross. The site and buildings were presented by the company to the University of London for educational purposes in 1904.

THE treasurer of Guy's Hospital has received a bequest of 1000*l.* under the will of the late Dr. C. J. Oldham, of Brighton, for the purpose of endowing an annual prize in ophthalmology at the medical school. A further anonymous donation of 200*l.* has also been received for the fund of the endowment of medical education and research.

MR. HAROLD HILTON has been appointed lecturer in mathematics at the Bedford College for Women (University of London). Mr. Hilton is a former fellow of Magdalen College, Oxford, and has for the past five years been on the teaching staff of the University College of North Wales. He is the author of a treatise on the mathematical theory of crystallography, and of numerous papers published in the Proceedings of the London Mathematical Society and elsewhere.

SINCE the disastrous fire which partially destroyed the main building of the Merchant Venturers' Technical College, Bristol, in October last, various sites for the re-erection of the college have been suggested and carefully discussed. A report advising the retention of the present site was adopted by the Society of Merchant Venturers on Friday last, and steps will, therefore, be taken at once to replace the various laboratories, workshops, lecture theatres, &c., with all possible speed. In framing plans for re-building, the Merchant Venturers will bear in mind the possibility that at some future period the college may be called upon to take its proper part in the formation of the proposed University of Bristol.

THE Board of Education has issued a return showing the extent to which, and the manner in which, local authorities in England and Wales have applied funds to the purposes of technical instruction and other forms of education other than elementary during the year 1904–5. The total number of authorities having powers in respect of education other than elementary was, for the year under consideration, 1203; of these, sixty-three were county councils, seventy-one county borough councils, and the remainder councils of non-county boroughs or urban districts. All the county councils and county borough councils, and 431 of the councils of non-county boroughs or urban districts, incurred expenditure for higher education. Particulars are provided as to money spent upon secondary schools, including pupil-teacher centres; evening schools and institutions for higher and technical education; exhibitions, including payment of fees; salaries for administrative officers, legal expenses, and general administration; and in respect of loans. The total expenditure in England and Wales on higher education, understood as including the work of institutions mentioned, was, in 1904–5, 2,889,871*l.* The amounts under the more important headings were:—secondary schools, 736,966*l.*; evening schools and institutions for higher and technical education, 1,382,162*l.*; exhibitions, 248,007*l.*; training of teachers, 48,835*l.*; administrative and legal expenses, 152,605*l.* The detailed information provided in the tables should prove of great value to members of education committees desiring to compare the expenditure in their own districts with that in other areas.

MR. MCKENNA, President of the Board of Education, addressed a letter on February 19 to Sir Francis Mowatt, the first chairman of the departmental committee on the Royal College of Science, concerning the proposed Imperial College of Applied Science at South Kensington, to the delay in the inauguration of which we referred last week. Mr. McKenna says that the time which has elapsed since the appearance of the committee's report has not been wholly wasted, because the problem has become clearer and the institutions concerned have become more nearly agreed as to the necessities of the case. After reviewing the alternative courses pressed upon the consideration of the Board of Education, the president expresses the opinion, maintained in these columns, that the point of determinative importance in the whole situation now is that there should be no further avoidable delay in bringing about the establishment of the new institution. The gratifying announcement is then made that the King is to be petitioned for a Charter for the new institution on the lines unanimously recommended by the departmental committee in January, 1906, and set forth in the draft proposals circulated by the Board of Education last July. The special governing body suggested by the departmental committee is to be appointed forthwith, and the institution to be developed as soon as possible. Mr. McKenna concludes his letter by requesting Sir Francis Mowatt to intimate to the Senate of the University of London that after an interval of time sufficient to permit of the full development of the governing body for the new institution, he will be prepared to advise the appointment of a Royal Commission to consider whether the amalgamation of the new institution with the University of London is desirable and feasible.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, December 13, 1906.—"Further Observations on the Effects produced on Rats by the Trypanosomata of Gambia Fever and of Sleeping Sickness." By H. G. **Plimmer.** Communicated by Dr. C. J. Martin, F.R.S.

From the results of 211 experiments, extending over a period of nearly three years, it appears that the tentative deductions which the author made in his preliminary note (Roy. Soc. Proc., vol. lxxiv.) from the few experiments therein recorded, that Gambia fever and sleeping sickness are two distinct diseases, cannot be maintained.

This extended series of experiments and observations goes to show that each of these two strains of Trypanosomata has produced two different effects in the same class of animals, under conditions of which we at present know nothing; that these effects are alike for the two organisms; and that the Trypanosomata found in these two types of disease are one and the same organism, modified by passage from man through monkeys to rats, and perhaps in the strains used by the author, by transplantation into animals of, and in, another country.

Faraday Society, January 29.—Prof. H. E. Armstrong, F.R.S., in the chair.—Discussion on osmotic pressure, opened by the **Earl of Berkeley,** who exhibited and described his apparatus for the direct measurement of osmotic pressure. The ordinary direct method of measuring osmotic pressures is to obtain equilibrium on the two sides of the semi-permeable membrane by means of the pressure of a head of liquid. The method devised by the author and Mr. E. G. J. Hartley substitutes mechanical pressure, which is put straight on to the solution, and equilibrium thus obtained. A vapour-pressure method for measuring osmotic pressure was also described.—Indirect methods of measuring osmotic pressure: W. C. Dampier **Whetham.** The speaker agreed as to the importance of the vapour-pressure method. He discussed the formula used by Berkeley and Hartley, and explained the difference between it and the van 't Hoff formula obtained from thermodynamic considerations, the expressions being identical where there is no change of volume of the solvent as it enters the solution.—Osmotic pressure from the standpoint of the kinetic theory: Dr. T. M. **Lowry.** The application of the equation $PV=RT$ to the osmotic pressure of gases could be predicted on general theoretical grounds, but there was no *a priori* reason for supposing that it would be applicable to the case of liquids. In the early years of the osmotic discussion it had been assumed by van 't Hoff and others that since osmotic pressures and gas pressures could be calculated by means of the same formula the conditions must be identical in the two cases, and it was definitely stated that in dilute sugar solutions the osmotic pressure was wholly due to the bombardment of the membrane by the molecules of the sugar, the effects produced by the water molecules being substantially identical on either side of the membrane. The alternative view, that osmotic pressure represented a diminution in the activity or "active mass" of the solvent, was suggested by Poynting in 1896, and had sub-

sequently been advocated by Armstrong, Beilby, van Laar, and others. The simplest case of a semi-permeable membrane is undoubtedly to be found in the surface of separation between liquid and vapour. At such a surface the kinetic theory postulates a continual interchange of molecules between the two phases. But whilst the rate of escape or evaporation would be reduced by the presence of non-volatile molecules in the surface, the rate of condensation would be unaffected, and equilibrium could only be restored by decreasing the vapour pressure, and so diminishing the rate of condensation at the surface of the solution. In this case a quantitative relationship could be deduced.—The bearing of actual osmotic experiments upon the conception of the nature of solutions: Prof. L. **Kahlenberg.** The occurrence of osmosis and its direction and extent are determined by the nature of the septum and of the liquids that bathe it. Experiments have shown, too, that there is always a major and minor current present, following in opposite directions, although it often appears as if the osmotic process were one-sided. In this case the septum is termed "semi-permeable," and recent research has centred around so-called semi-permeable membranes which really do not exist. The author has demonstrated that it is peculiarly strong selective action on the part of the septum which causes it to be approximately semi-permeable in certain cases, and he has recently even succeeded in separating two colloidal substances by dialysis. This selective action is due to the solubility or insolubility of the substances concerned in the membrane, and therefore osmotic pressure is due to the same forces—essentially chemical in character in the opinion of the author—as the process of solution, and they may be quite variable as different septa and different liquids are employed. The usually accepted "sieve theory" is untenable, because larger molecules frequently go through a membrane more readily than smaller molecules.—Tables containing a summary of the recent experiments made with glucose and cane-sugar: H. N. **Morse.** The conclusions arrived at are:—(1) In the vicinity of 20° the osmotic pressure exerted by either is equal to that which a molecular equivalent quantity of a gas would exert if its volume were reduced, at the same temperature, to the volume of the solvent in the pure state. (2) Between 18° and 26°, at which the measurements were made, both cane-sugar and glucose in solution are in the anhydrous condition. Measurements made just above 0° yield pressures somewhat above the calculated gas pressures. Measurements with electrolytes are about to be made in which osmotic pressure and dissociation will be determined simultaneously.

Entomological Society, February 6.—Mr. C. O. Waterhouse, president, in the chair.—*Exhibitions.*—E. A. **Cockayne**: A collection of Lepidoptera made at Tongue, North Sutherlandshire, between June 30 and July 13, 1906, comprising many species not hitherto reported from the county. The several species showed little tendency to melanism.—Dr. T. A. **Chapman**: Specimens of *Hastula hyerana*, Mill., to demonstrate how it may vary towards melanism in the circumstances of late or retarded emergence.—Miss M. E. **Fountaine**: Examples of Anthocharid and Melitæid butterflies from various localities in the Palæarctic regions, showing a wide range of variation.—The **President**: A female example of the genus Dorylus from Mengo, in Uganda, and one small and two large workers, which would probably be the means of identifying the species. The workers closely resemble specimens in the museum named *D. arcens*, which are said to be the same as *nigricans*.—Rev. F. E. **Lowe**: Various aberrant forms of Swiss butterflies, including *Melanargia galatea*, ab. *fulvata*, Lowe, from Martigny; *Lycaena arion*, from Pontresina, with the black markings on the underside of the wings almost entirely absent, save one very large kidney-shaped spot, slightly tinged with white at the centre of each wing; and a pair of *Pieris napi*, var. *bryoniae*, taken *in cop.* at Caux, the ♂ not only suffused as in *bryoniae*, but also having the ♀ markings.—Colonel Charles T. **Bingham**: The pupa of a Tineid moth, probably of the genus Brinsitta, from Upper Burmah, presenting with its surroundings a remarkable mimetic resemblance to the head and body of a snake; and a case showing the curious habit of butterflies of the genera Gerydus and Allotinus attending with ants on Aphidæ for their sweet exudations.—Rev. F. D. **Morice**: A very remarkable gynandromorphous specimen, from Silchester, of the common fern-visiting sawfly, *Strongylogaster cingulatus*, the dividing line between the ♂ and the ♀ portions running longitudinally, not transversely, from end to end of the creature; a form probably unique.—*Papers.*—Notes on the Indo-Australian Papilionidæ: Percy I. **Lathy.**—The hymenopterous parasites of Coleoptera: E. A. **Elliott** and Claude **Morley.**

Geological Society, February 6.—Dr. J. E. Marr, F.R.S., vice-president, in the chair.—Note on the cervical vertebra of Zeuglodon from the Barton Clay of Barton Cliff (Hampshire): Dr. C. W. **Andrews.** The author gives a brief description of a cervical vertebra from the Barton Clay of Barton Cliff. It is referred provisionally to *Zeuglodon wanklyni*, a species described in 1876 by Prof. H. G. Seeley. The skull on which this description was founded is totally lost, so that this vertebra is the only bone of a Zeuglodon from the Barton Clay, and, with the possible exception of a vertebra from the Brockenhurst beds (which is the type of *Balaenoptera juddi*), the only one found in the British Isles that now exists.—The origin and age of the plateaus around Torquay: A. J. **Jukes-Browne.** The existence of high-level plains or plateaus near Torquay has long been known, but since Pengelly's time little attention seems to have been paid to them. Pengelly believed that there were several such plains at different levels, and thought that the time of their production was not very remote. On examination, however, his evidence breaks down, and the author regards the plateaus as portions of one inclined plain. The age of the planation is shown to be post-Permian, by the fact that Permian breccia forms part of the plateau-surface at St. Marychurch. It is also probably post-Cretaceous, because Cretaceous planation is not likely to have removed all the Permian. Its present dissected condition shows that it is older than the Pleistocene, and consequently an Eocene date would agree with local evidence.

Linnean Society, February 7.—Lieut.-Colonel Prain, F.R.S., vice-president, in the chair.—Some observations of climbing plants: Rev. John **Gerard,** S.J. The author began by pointing out the two opposing methods of describing spiral growth or torsion as viewed from the exterior or from the interior of the spiral, the result being that the "dextrorse" of the first is the "sinistrorse" of the second method. With or against the sun, which applies to the northern hemisphere, is reversed in the southern hemisphere, and for these reasons he preferred to use the terms "clockwise" and "counter-clockwise" (shortened to "counterwise"), the honeysuckle (*Lonicera Periclymenum*) and the hop (*Humulus Lupulus*) turning clockwise, and the convolvulus (*Convolvulus arvensis*) and the scarlet-runner bean (*Phaseolus vulgaris*) twining counterwise. He showed the result of some experiments he had made by growing scarlet-runner beans in opaque cylinders, to discover, if possible, whether the deviation of the twist were innate, or from the direction of the light, the conclusion being drawn that the plant possessed an inclination resembling the instinct of animals, of proceeding in a given direction, and resented any attempt to force it otherwise. The author concluded with some observations on the behaviour of tendrils, as those of *Bryonia dioica*, displaying one specimen which had varied the torsion four times, and showed ten turns in one direction against seventeen in the contrary.—New plants from Malaya: Dr. Otto **Stapf.** The author gave the history of his new genus Hallieracantha, which receives eight species from the genus Ptyssiglottis, Hallier f., and eleven others are added from the Kew collections; they form a very homogeneous group, are eminently shade-loving plants, and exhibit anisophylly in a very marked degree. The headquarters of the genus are in Borneo.—Tertiary Foraminifera of Victoria. The Balcombian deposits of Port Phillip: F. **Chapman.**

Physical Society, February 8.—Prof. J. Perry, F.R.S., president, in the chair.—Annual general meeting.—Presidential address: Prof. **Perry.** In concluding his address, Prof. Perry remarked that a standard boy should know decimals at eight, he should use squared

paper to record his own experimental results at nine, he should solve interesting problems using squared paper and logarithms and tables of sines and cosines at the age of ten and eleven, and he should get the notion of a rate long before he was twelve. He would have an elementary knowledge of the infinitesimal calculus before he was fourteen. He considered the elementary use of the calculus, and even the solution of easy differential equations, a school and not a university subject. Spherical harmonics and Bessel functions and their use in all sorts of physical problems with actual curve drawing, was an undergraduate study. Permutations and combinations and the theory of probability were post-graduate subjects, like the study of the fifth book of Euclid.—The magnetic field and inductance coefficients of circular, cylindrical, and helical currents: A. **Russell.** The author gives formulæ for the magnetic force near a circular current which can be readily evaluated. He then shows how the self-inductance of a ring of wire and the mutual inductance between two coaxial circular filaments can be found without using Neumann's theorem. By Kelvin's method, the results obtained can be applied at once to the corresponding problem of the simple vortex filament in hydrodynamics. In this way expressions are found for the velocity of translation of a circular vortex filament—about which there appears to be uncertainty in hydrodynamical theory—and for the energy of the motion. The exact formula for the mutual inductance between a cylindrical current sheet and a coaxial helical filament of current is obtained. It is expressed both in terms of elliptic integrals and in the form of an algebraical series.

MANCHESTER.

Literary and Philosophical Society, December 11, 1906.—Mr. Francis Nicholson in the chair.—The discovery by Bütschli of strontium sulphate as the basis of the skeleton in certain Radiolaria (Acantharia): Dr. F. W. **Gamble.** Working with material brought back by the German Antarctic Expedition, and also upon Mediterranean Acantharia, Bütschli has shown that strontium sulphate is the material of which the complex rods and spicules of these Radiolaria are composed. This is the first time that strontium has been described in animal tissues, and coincides with the recent discovery of barium sulphate in certain other deep-sea Protozoa (Xenyophophoridæ).—The parichnos in the Lepidodendraceæ: Prof. F. E. **Weiss.** This somewhat problematical organ appears as two small marks on the leaf scars of Lepidodendron and Sigillaria. It is found to consist of a thin-walled tissue communicating with the interior of the stem, and has been regarded by some as concerned in the transpiratory function of these extinct plants. Prof. Weiss brought forward arguments in favour of comparing them to the breathing pores of trees known as lenticils.—The structure of syringodendron, the bark of Sigillaria: Miss K. H. **Coward.** An account was given of a particular instance of the above-mentioned breathing pores in Sigillaria.

January 15.—Sir W. H. Bailey, president, in the chair.—The positions of Mendeléeff's groups of chemical elements: C. E. **Stromeyer.** With the help of an empirical formula, which, like Stoney's logarithmic spiral of the cube roots of the atomic weights, gives average results, the author has calculated the mean positions of the various chemical groups, and finds that they are not equidistant, but are irregularly spaced like the musical notes of the major or minor scale. Dividing the iron groups into three, viz. iron, nickel, and cobalt, the chief irregularities may be summarised as follows:—The manganese and the iron groups, as well as the nickel and cobalt groups, fall nearly together, viz. 6·64, 6·82, and 7·59, 7·80, whereas the oxygen and fluorine groups, the cobalt and sodium groups, and the magnesium and aluminium groups are separated from each other by about one and a half average group intervals, viz. 5·27, 6·64, and 7·80, 9·29 and 9·82, 11·37. By assigning their mean positions to the groups, instead of the whole numbers (one to sixteen) as has been done previously, the author's empirical formula expresses very accurately the atomic weights, the chief discrepancies being found amongst the recently discovered rare elements and amongst the sulphur group. The conclusion arrived at by the author is that the atomic weights cannot be expressed by a single continuous curve, even if irregular positions are assigned to the groups.

January 29.—Mr. Francis Nicholson in the chair.—A confusion of two species of Lepidodendron (*L. Harcourtii*, Witham, and *L. Hickii*, sp.nov.) under *L. Harcourtii*, Witham, in Williamson's nineteenth memoir, with a description of *L. Hickii*, sp.nov.: D. M. S. **Watson.** In his nineteenth memoir, Williamson describes several stems as *L. Harcourtii*, Witham. Examination of these sections has shown that whilst one is probably *L. Harcourtii*, the majority belong to a type which differs from *L. Harcourtii*, Witham, in several particulars.—A collection of mammals made by Mr. S. A. Neave in Rhodesia, north of the Zambesi, with field notes by the collector: R. C. **Wroughton.**

PARIS.

Academy of Sciences, February 18.—M. Henri Becquerel in the chair.—The president announced the death of M. Marcel Bertrand, member of the section of mineralogy.—Researches on the combinations between carbon and free nitrogen: M. **Berthelot.** When acetylene is decomposed by electric sparks, there is no trace of the reverse reaction, the formation of cyanogen from its elements. The author holds that there is no conclusive evidence that carbon and nitrogen combine directly at any temperature; observations to the contrary are due to the impurities in the carbon or nitrogen.—Some catalytic reactions effected under the influence of wood charcoal: Georges **Lemoine.** At a temperature of 350° C. wood charcoal causes the decomposition of alcohol into hydrogen and aldehyde. Hydrogen peroxide is freely decomposed into oxygen and water at low temperatures, and the reaction between iodic acid and oxalic acid is also accelerated by charcoal.—Remarks on the spectroheliograph: G. **Millochau.** Commenting on a recent paper by MM. Deslandres and Azambuja, the author directs attention to the spectroheliograph described by him in conjunction with M. Štefánik two years ago, and gives fuller details of the arrangement.—The theory of gases and globular clusters: H. **v. Zeipel.** An application of the theory of gases to the study of the distribution of stars in globular clusters.—A simple apparatus reproducing all the peculiarities of Foucault's experiment on the rotation of the earth: G. **Blum.**—Quasi-integral and quasi-meromorphic functions: Edmond **Maillet.**—The growth of integrals of differential equations of the first order: Pierre **Boutroux.**—The construction of a radius of curvature of the curves enveloped in the most general movement of a solid body: G. **Kœnigs.**—The variation of the vapour pressure as a function of the pressure and the determination of the ebullioscopic constants: Georges **Baume** and D. E. **Tsakalotos.**—Some molecular combinations of metallic halides with organic compounds: V. **Thomas.** The reaction between certain metals, such as zinc, aluminium, and magnesium, is accelerated by organic substances, such as ether or alcohol. The author has made a systematic study of the various classes of organic substances capable of inducing this reaction. Besides ether and alcohol, the fatty ketones, the diketones, and nitriles all induce the reaction. The aromatic ketones, on the other hand, paraldehyde, and certain aromatic aldehydes, are without effect. These effects are traced to the formation of molecular compounds of the type $CH_3.CO.CH_3.MgI_2$.—Note concerning the estimation of gold by the wet method in auriferous sands: Albert **Fournier.** The presence of iron is the main difficulty in the estimation of gold in the wet way; the method described shows how this difficulty can be avoided.—The reducing and catalytic power of amorphous carbon towards alcohols: J. B. **Senderens.** Finely divided, carefully purified animal charcoal was used in the experiments. At 400° C. ethyl alcohol gives ethylene and methane, with small quantities of hydrogen, carbon monoxide, and dioxide. With propyl alcohol, the gases contained propylene (88 per cent.) ethane, with small quantities of hydrogen and carbon monoxide. Fine sand exerts a stronger catalytic action than charcoal, and may be used with advantage in the preparation of certain ethylenic hydrocarbons. Red phosphorus at 200° C. to 240° C. induces this catalysis even better than sand.—The migration of the soluble principles in the plant: G. **André.**—

Transformations in the organism and elimination of formic acid and the formates: C. **Fleig.** In the intestines the formates can be converted into carbon dioxide, hydrogen, and a carbonate, chiefly by microbial action. In the veins there is probably an oxidation of a diastatic nature.—The brusque character of the activation of the pancreatic secretion by calcium salts: C. **Delezenne.**—Viviparous Diptera of the family of the Muscidæ, with larvæ sometimes parasitic, sometimes vegetarian: J. Künckel **d'Herculais.**—Histolysis, without phagocytosis, of the vibratory muscles of flight in queen ants: Charles **Janet.**—The fructification of pathogenic fungi in the interior of human tissues: Charles **Nicolle** and M. **Pinoy.**—Fundamental differences in the mechanism and evolution of the increase of resistance to infection according to the methods utilised: MM. **Charrin** and **Lévy-Franckel.** From experiments on rabbits it is concluded that antidiphtheric serum behaves as a drug, the effects of which pass off, as it only acts during the time of its presence, the organism remaining inert. The toxin, on the contrary, causes a reaction on the part of the tissues, which, once set up, confers a new property on the cells which is more durable.—Researches on the transplantation of nerve ganglions: G. **Marinesco** and M. **Goldstein.**—Studies on the mechanism of the destruction of nerve-cells in old age and the pathological states: M. **Manouélian.** From the experiments given in detail the author concludes that in old age, as in pathological states, the nerve-cell undergoes similar changes. In the normal state the satellite cells play an important function in the ordinary working of the nerve-cell, but in old age these satellite cells exhibit a remarkable vitality; they multiply, attack the nerve-cell, penetrate its interior, and destroy it.—The different modes of volcanic activity in the chain of the Puys: Ph. **Glangeaud.**—The sea floor between Madagascar, Réunion, and Mauritius: J. **Thoulet.**

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 28.

ROYAL SOCIETY, at 4.30.— On the Dispersion in Artificial Double Refraction: Dr. L. N. G. Filon.—The Occlusion of the Residual Gas by the Glass Walls of Vacuum Tubes: A. A. Campbell Swinton.—The Theory of Correlation for any Number of Variables, treated by a New System of Notation: G. Udny Yule.

FRIDAY, MARCH 1.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Discussion continued by Sir William H. White, K.C.B., on the Eighth Report to the Alloys Research Committee: on the Properties of Alloys of Aluminium and Copper: Prof. H. C. H. Carpenter and C. A. Edwards. (Prof. Carpenter will reply to the Discussion.)

GEOLOGISTS' ASSOCIATION, at 8.—A Geologist's Impressions of Mexico: M. M. Allorge.

SATURDAY, MARCH 2.

ROYAL INSTITUTION, at 3.—Röntgen, Kathode, and Positive Rays: Prof. J. J. Thomson, F.R.S.

MONDAY, MARCH 4.

VICTORIA INSTITUTE, at 4.30.—Orissa; its History and People: C. W. Odling.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—Exhibition of a Gas Calorimeter: Prof. C. V. Boys, F.R.S.—Four Years' Experience in Metering Producer Gas, and continuously recording its Calorific Power: Prof. R. Threlfall, F.R.S.

TUESDAY, MARCH 5.

ROYAL INSTITUTION, at 3.—The Visual Apparatus of Man and Animals: Prof. William Stirling.

SOCIETY OF ARTS, at 4.30.—British Malaya: Sir W. H. Treacher, K.C.M.G.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Continued discussion*:—On the Limits of Thermal Efficiency in Internal-Combustion Motors: Dugald Clerk.—*Paper*:—The Construction of Overhead Electric Transmission Lines: A. P. Trotter.

ZOOLOGICAL SOCIETY, at 8.30.

WEDNESDAY, MARCH 6.

SOCIETY OF ARTS, at 8.—The Discovery of the South-eastern Coalfield: Prof. W. Boyd Dawkins, F.R.S.

ENTOMOLOGICAL SOCIETY, at 8.—The Life-History of *Tetropium gabrieli*, Weise: Rev. G. A. Crawshay.—Revision of the Chelisochidæ and Forficulidæ: Malcolm Burr.—Descriptions of some New Butterflies from Tropical Africa: Hamilton H. Druce.

SOCIETY OF PUBLIC ANALYSTS, at 8.—The Disposition and Analyses of Sewage Matters deposited on Superposed Surfaces: W. J. Dibdin.—The Composition of Milk: H. Droop Richmond.—Preservatives in Milk and Milk Products, (1) The Souring of Milk and the Effect of Preservatives thereon: (2) Notes on the Detection and Estimation of Preservatives: H. Droop Richmond and E. H. Miller.

THURSDAY, MARCH 7.

ROYAL SOCIETY, at 4.30.—*Probable Papers*:—Experiments with Vacuum Gold-Leaf Electroscopes on the Mechanical Temperature Effects in Rarefied Gases: Dr. J. T. Bottomley, F.R.S., and F. A. King.—On the Resistance of Air: A. Mallock, F.R.S.—Electric Furnace Reactions under High Gaseous Pressures: R. S. Hutton and J. E. Petavel.

CHEMICAL SOCIETY, at 8.30.—The Constitution of Chaulmoogric and Hydnocarpic Acids: M. Barrowcliff and F. B. Power.—Volume Changes which accompany Transformations in the System $Na_2S_2O_3$, $5H_2O$: H. M. Dawson and C. G. Jackson.

AERONAUTICAL SOCIETY, at 8.—Wings *v.* Screws: Colonel J. D. Fullerton, R.E.—The Free Lever in the Flying Machine: Herr Karl Milla.—Theory of Sailing Flight: José Weiss.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.——The Transmission of Electrical Energy by Direct Current on the Series System: J. S. Highfield.

LINNEAN SOCIETY, at 8.—On the Development of the Frog: Miss N. F. Layard.—Biscayan Plankton, Decapoda: S. B. Kemp.—A Special Point in the Colour Adjustment of Chamæleon: Prof. E. B. Poulton, F.R.S.—New Channel Island Plants: G. Claridge Druce.—*Exhibitions*: Specimens of *Nitella ornithopoda*, A.Br.: H. and J. Groves.—(1) Probate of the Will of Richard Anthony Salisbury; (2) Manuscripts of Dr. W. J. Burchell: Prof. E. B. Poulton, F.R.S.

CIVIL AND MECHANICAL ENGINEERS' SOCIETY, at 8.—Types of Enclosed Steam Water Heaters: C. R. Allensby.

FRIDAY, MARCH 8.

ROYAL INSTITUTION, at 9.—Certain Seasonal Diseases of the Sheep, and the Means of Preventing Them: Prof. D. J. Hamilton.

PHYSICAL SOCIETY, at 8.—The Rate of Recovery of Residual Charge in Electric Condensers: Prof. Trouton and Mr. Russ.—Experimental Mathematics: Mr. Pichon.—An Instrument to describe Families of Equiangular Spirals: Mr. Blakesley.—A Micromanometer: Mr. Roberts.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Corrugations on Tram-Rails: A. T. Arnall.

MALACOLOGICAL SOCIETY, at 8.—On the Non-Marine Mollusca of the Mylne Collection: A. S. Kennard and B. B. Woodward.—Notes on Holocene Mollusca from Ightham: A. S. Kennard and B. B. Woodward.—Descriptions of Four New Species of Melania from New Ireland and Ke-lan-tan: H. B. Preston.—On the Arms of the Belemnite: G. C. Crick.

SATURDAY, MARCH 9.

ROYAL INSTITUTION, at 3.—Röntgen, Kathode, and Positive Rays: Prof. J. J. Thomson, F.R.S.

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