THURSDAY, JANUARY 20, 1898.

THE PHYSIC OF OUR FATHERS.

Vita Medica; Chapters of Medical Life and Work. By Sir Benjamin Ward Richardson, M.D., LL.D., F.R.S. Pp. xvi + 496. (London: Longmans and Co, 1897.)

THIS work, Mr. Bertram Richardson tells us, was finished by his father on Wednesday, November 18, 1896, just before eight o'clock in the evening. At ten he was seized with the illness which ended fatally on Saturday morning, November 21. Thus a pathetic interest attaches to these last words of a singularly interesting and gifted man. Not a few errors in the text, such as the misspelling of proper names, and so forth, are due no doubt to the want of the author's revision.

The work may be roughly divided into the biographical part, and a second part in which the author, as if with a prescience of death, tells us of the ideas which had occupied his thoughts in his later years. We trust that we may be forgiven for saying that the former part is by far the more interesting. If Sir Benjamin's style occasionally offend the purist, he nevertheless writes in a vigorous, graphic, and even picturesque fashion, which is far better than mere purity. Although no one would have been more reluctant than the author himself to have his style compared to that of so splendid and accomplished a master of prose as Mr. Ruskin, yet we admit that on reading the first part of this book we were reminded of the charming "Praeterita," in its winning egotism without self-conceit, its happy delineation of character, and its broad humanity. We were greedy of more, and confess to a disappointment when other matters, which the author no doubt regarded as more important, cut short the personal narrative. Not only so, but the narrative itself is diversified by reflections always shrewd and kindly, often acute and original. The admirable portraits of those most interesting of men the old-fashioned country practitioners of medicine—such as Dudley Hudson and Willis—are excellent; in these pages the abler sort of country doctor, with his rugged kindliness, his curious stores of ill-digested learning, his flashes of humorous insight, his devotion to his calling, and his readiness of resource in emergencies, is described to the life. The modern practitioner, however, has some grasp of principles, whereas his predecessor, for the most part, hated ideas; if the modern doctor be inferior to his predecessor in mother wit, less curious in his mental furniture, and wanting in the vigorous eccentricity of manner and thought which made his predecessor entertaining as a character, yet his education in scientific methods makes him a far more enlightened practitioner of a very abstruse and complicated art. We insist on this distinction between the scientific physician and the merely practical doctor, because we think Sir Benjamin Richardson, in his advocacy of the old system of apprenticeship, which no doubt taught well the arts of managing men and horses and of smelling out drugs in the dark of the night, left out of view that cultivation in the broader principles of medicine as a science which nowadays mark the modern practitioner even in country places. For lack of a greater breadth of mental training the Dudley Hudsons, the Willises, and the rest, keenly as they loved curious detail, gained no wide reputation. Moreover, but few apprentices had remarkable men for their teachers; "first catch your despot." The men who stimulated and instructed the young Richardson were singularly able men; too many medical apprentices fell under the guidance of masters whose endowments, natural or acquired, were often little above those of the contemporary cow doctor.

Many points of more than local interest are touched upon in the course of the biographical sketch. Richardson emphasises the part taken by Perry of Glasgow in making known in Great Britain the distinction between enteric and typhoid fevers. Dr. A. P. Stewart, a pupil of Perry, helped to make popular the distinction so clearly taught by his master. The author also gives a very graphic account of the first operation under anæsthetics in Glasgow, by Andrew Buchanan.

Of that remarkable little town Saffron Walden, with its museum and its group of clever men, a very interesting account is given. The Exhibition of 1851 is recalled; and Richardson tells us that its effect—and we may add that of the development of the railways—on the health of women, and consequently on the doctor's income, was one of its unexpected results: women whose lives had been spent in valetudinarianism rose from their sofas, and in the second half of the century forgot that the daily or weekly visits of the doctor had for generations been the principal event in the lives of themselves and such as they. To cycling as a means of health the author gives the same credit. Among other interesting facts he tells us also that he frequently attended in the camps of the gypsies, and found that this nomad way of life was far from a healthy one for the children of these folk In this and innumerable other departments of his life's work the author cannot prevent our perceiving that his devotion to the sick and sorrowful was at least as exemplary as that of those others of the noble band of genera practitioners to whose ranks he then belonged, and whose self-denying labours he has so admirably recorded.

Even in the scientific investigations, which more and more occupied his maturer life, love of man and an earnest desire to benefit his race were prominent. Fruitful as such aspirations are, Richardson might perhaps have done more for science if this love of knowledge had been more disinterested. We must not forget that even Pasteur's work was chiefly inspired by the hope of discovering the means of benefiting his fellow men, yet Richardson was not perhaps wholly free from some tinge of that Philistinism which too often colours the ideas of the benevolent man.

Perhaps Richardson's best work was that on the anæsthetic agents, and on the methods of anæsthesia, whether general or local. In the same spirit he sought a remedy for the terrible effects of clotting of the blood in the heart, or blood-vessels; and certainly the cases quoted by him in support of the method he advised, must command attention. In the sphere of antiseptic surgery, also, he worked hard at a time when its principles were so little understood that the author himself, neither then nor afterwards, was able to lay hold of the principles of bacteriology, on which study he makes adverse and belated reflections. We were unaware that while working at the ethers Richardson had recommended nitrite of amyl in angina pectoris, a therapeutic discovery which has been attributed to others.

The enthusiasm for humanity which dictated so many of these researches, led Richardson to the front of the battle in the causes of preventive medicine and of teetotalism. His splendid services in the field of sanitary reform are too well known to need record in these columns; his determined advocacy of total abstinence, no doubt, as he tells us, to his own pecuniary detriment, sprang again from his ardent humanity. Whether, right or wrong, he was as a lion in his aweless championship of all measures which, in his opinion concerned the well-being of the masses. At the same time, his report of the social ignominy which overtook those who advocated this unpopular cause, seems to us exaggerated. Higginbottom, of Nottingham, may, of course, have strode down the room at the Provincial Medical Association unregarded and even shunned of men; but the present writer well remembers the honour in which Higginbottom was held by his contemporaries in spite of his determined opposition to the use of alcohol; and the writer, who also enjoyed the friendship of other prominent teetotallers, such as Edward Baines, never heard worse words spoken against these blameless men than that they were the victims of a troublesome whim. In practice the public not unnaturally fight shy of a faddist, as they supposed the teetotaller to be; but, except in the society of topers, surely no teetotaller as such was ever shunned. Sir Benjamin's nephelococcygian dream of the ideal City of Health made a great effect upon the audience to whom the address was given. The earnest purpose and the fervent desire of the orator to benefit mankind gave a reality to a scheme which, of course, he put forward more or less as a phantasy.

In dwelling on the life of Sir Benjamin Richardson we are led to wonder how it was that a man so earnest, so able, so fertile in speculation, so ardent in his laboratory researches should have achieved comparatively little of permanent scientific value. On the other hand, we shall not forget that much of his energy was given to inspiring and directing the men of his time in social work which, if it cannot be formulated, was none the less permanent in its effects. We have hinted that the speculative part of the volume before us is less interesting than the narrative: the thoughts are turned out upon paper in a crude state, and, generally speaking, are no more than the floating thoughts of any able and thoughtful man. Nay, we cannot but feel that in their form we observe the ill effects of the very apprenticeship that he believed to be the best early education for a medical man. We believe that a more systematic training in scientific method in his earlier days would have led not only to a chastening of such speculations, but also to the attainment of scientific discoveries of a more abiding value. Nevertheless, we put down this book with a sense that men of Richardson's stamp—courageous and unwearied in the pursuit of truth—are the salt of our race; and that even in the most unsubstantial of his musings there is always an elevation of tone which reveals the noble and humane character of one so long a familiar figure among us, but whose voice we shall hear no more. T. C. A.

A NEW WORK ON POPULAR ASTRONOMY.

The Concise Knowledge Astronomy. By Agnes M. Clerke, A. Fowler, A.R.C.S., F.R.A.S., Demonstrator to the Royal College of Science; and J. Ellard Gore, F.R.A.S., M.R.I.A. With illustrations from photographs and drawings. Pp. x + 581. (London: Hutchinson and Co., 1898.)

THIS is a formidable array of authors, and the necessity for such a numerous combination is not at all clear. There is nothing in the book that any one of the three could not have written, and we might add that any one of the three could have written a better book, than the united efforts of the three have produced. While the separate parts, judged from a popular standpoint, are in many respects admirable, there is a want of cohesion in the whole, that is disappointing and unsatisfactory. Collaboration to be effective must be close and thorough; but here, facts are repeated by the separate authors in a way which annoys, and statements are divided between the different writers in a manner which disturbs, a reader. Efficient editing could have prevented a good deal of this overlapping, and have dovetailed the parts together with more skill; but the cumbrous machinery that necessitated an editor at all was a mistake. Can any one suppose that there is any material gain in taking the chapters on the sidereal universe out of Miss Clerke's hands and placing them in those of Mr. Gore, or that Mr. Fowler was incapable of describing the main features of the several members of the solar system? Judging from the result before us, an elementary book is not increased in accuracy nor benefited in arrangement by distributing the compilation among several authors.

Of the trinity here under consideration, Miss Clerke is the largest contributor. To her is entrusted the opening chapters, sketching the history of the science from Hipparchus to the present time. In her hands, a sketch, however brief, is sure to be well arranged and graphically written. We confess, however, to a little disappointment that more space is not given to the development of spectroscopy, and this remark applies not only here but throughout the book generally. Owing to considerations of space it might have been necessary to curtail, or even to exclude, all reference to Mohammedan, and possibly to pre-Newtonian science in these opening chapters; but this loss would have been more than compensated by impressing on the average reader the importance of astrophysics and the part it plays, and in the immediate future, will play, in the development of astronomical science. It must be, no doubt, always a difficult task to know what facts are to be suppressed, and to what others prominence must be given, in order to preserve in due perspective the salient features that mark the onward progress of a science. But full advantage has not been taken of the marvellously rapid development of astrophysics to make it an incentive to the study of astronomy. The facts, and possibly the speculations, of spectroscopy have a great fascination for the general reader. The results can be presented without reference to mathematical formulæ, and by the powerful appeal they make to the imagination, they are eminently calculated to excite public enthusiasm and arouse an intelligent interest in the community. Surely one of the objects, if not the main object of such a book as this, is to promote the cultivation of the science among an instructed, but not specially instructed, public. For whom else is the book written? It is not a work of reference intended to be used by the astronomer; it is not sufficiently full. The earnest student of astronomy is catered for by treatises of a more serious character. In point of fact the book occupies, to some extent, the ground which Sir Robert Ball has so well covered, and appeals generally to the same class of readers.

Another disadvantage springs from this slight, and Miss Clerke must pardon us if we say, unworthy, sketch of spectroscopic advance. Justice is not accorded to those who have worked strenuously and successfully as pioneers in this branch of science. One unacquainted with the history of the science might suppose that our knowledge of it began and ended with the work of Sir William Huggins. We do not mean to imply that there is one word here that is not justified by his great reputation, but only to regret that the names of other equally earnest and equally capable workers are suppressed. We think the omission of all reference to the work of other physicists, both at home and abroad, makes the survey of the general progress of the science too incomplete, and might indeed be likened to the representation of Hamlet with the omission of the Prince of Denmark. No doubt the prominence given to some astronomers, and the silence maintained with regard to others, are accidental; but it unfortunately suggests that the author's mind is warped in special directions, preventing a wholly unprejudiced survey being taken, and suggesting a biassed arrangement of the facts. Happily, in such an elementary work, when we come to greater detail, points still open to controversy and further elucidation do not come before us. We have only to deal with admitted and recognised truths, and here Miss Clerke is a safe guide. The section describing the solar system leaves little to be desired; few could probably have arranged an equal number of facts in the same space without becoming dull and wearisome. By the admirable illustrations supplied, we are in some instances enabled to see the planets and the details of their surface markings as they are revealed in the most powerful telescopes, while the latest views and speculations of the observers are recorded with ample fulness. We anticipate that on this section the general reader will dwell with the greatest interest and delight.

Mr. Fowler's work, without much reason, is sandwiched in between the preliminary historical chapter and this description of the solar system. It is termed geometrical astronomy, not a very happy title, but spherical was, no doubt, felt to be too ambitious a description, and it certainly does deal with many of the problems that belong to the earth's figure and motions. Trigonometrical expressions are practically excluded, but by the aid of diagrams a good many simple problems are very satisfactorily explained. The description of instruments is an interesting feature in this section, and is written with that simplicity and clearness which characterises all Mr. Fowler's work when dealing with mechanical operations.

Mr. Gore furnishes the last part of this trilogy. His domain is the sidereal heavens, and, considering the space at his disposal, his work is very thoroughly done. We could have wished, and so possibly did Mr. Gore, that he had been allowed to use Greek letters to designate the stars in their respective constellations. An uncomfortable strange appearance is given to many old friends dressed up in this unfamiliar fashion. But when one gets over this peculiarity it will be found that the facts connected with binary systems, with temporary and variable stars, with the motion of the sun are clearly and accurately stated, and give a very complete idea of the present condition of our knowledge of the sidereal heavens.

A few very obvious errors are occasionally met with in the course of the book; but where so much has been read with pleasure, it seems a very ungracious task to place the finger on these few blots, which, no doubt, will disappear in subsequent editions. If any one prides himself on his accuracy, let him write an elementary textbook on a subject in which the facts are continually accumulating, and the deductions from them being constantly modified, and he will probably find that his self-complacency is scarcely warranted. W. E. P.

OUR BOOK SHELF.

Manuel d'analyse chimique appliquée a l'examen des produits industriels et commerciaux. By Émile Fleurent. Pp. iii + 582. (Paris: G. Carré et C. Naud, 1898.)

THE author states in his preface that he has written with a threefold aim, namely: (1) to give general methods of qualitative and quantitative mineral analysis and organic analysis of an elementary character, free from all details not absolutely useful; (2) to avoid methods of work that are too long for those who are pressed for time or who have not sufficient general knowledge, giving in each case only one method (or occasionally two) that leads quickly and surely to the desired result; and (3) to bring together in one volume the methods of examination of *the more important*, though the most diverse of the products which one meets with in the laboratory of the industrial chemist. Accordingly we find in some 556 pages of clearly printed and well-spaced matter some preliminary observations with reference to apparatus, a section on qualitative analysis, and methods for the quantitative examination of the commoner metals and minerals containing them, besides, among other things, water, inorganic pigments, cements, &c., compounds of the alkalis, manures of various kinds, soils, animal and vegetable products, such as cellulose, tannin, milk, fruits, fermented liquors, wines, and textile fabrics, the estimation of acetone in methylated spirit, and the determination of the flashing point of petroleum, &c. It is obvious that where so much ground is covered in so comparatively small a space, that in some cases at least there cannot be room for more than a mere summary of the details of the method given. It is generally a matter of opinion as to which is the best of several alternative methods, and often, too, a slight variation in the sample from what is most usual, renders a variation in the process desirable. It must have been a very difficult task to select the one or two methods in each case; but, taken as a whole, they are fairly representative. If the space devoted to the figures of beakers and other apparatus, and to the exceedingly meagre description of the qualitative reactions of the common acids and bases had been devoted to an expansion of the other part of the book, the usefulness of the volume would have been much increased. We doubt, for example, the need for telling any one who concerns himself with such work as is here described, that mercuric salts give a precipitate with sulphuretted hydrogen which changes from white to black, and is insoluble in alkaline sulphides; that hydrochloric acid and chlorides give no precipitate, and that iodide of potassium gives a beautiful red precipitate very soluble in excess of the reagent. These are all the qualitative reactions given for mercuric salts, and it may well be said of them that, though true, they are not the whole truth even concerning the precipitates mentioned. As a reminder for students who have to learn what they can about many things in a very little time, the volume will no doubt prove very valuable, and the practical analyst will sometimes find suggestions that will prove useful to him.

First Book of Physical Geography. By Ralph S. Tarr, B.S., F.G.S.A. Pp. xxviii + 368. (New York: The Macmillan Company. London: Macmillan and Co., Ltd., 1897.)

PROF. TARR explains that his reasons for following his "Elementary Physical Geography" (noticed in NATURE, vol. liii. p. 293) by the present smaller work, is that "many teachers who wish to give instruction in the *new physical geography* are unable to make use of it," on account, apparently, of the educational regulations in the United States. Although Prof. Tarr italicises the *new physical geography*, we are unable to see that this book differs essentially in subject-matter from such a long established schoolbook as Geikie's "Elementary Lessons in Physical Geography"; and although with regard to arrangement and style there are variations, these present no special novelty.

Part i. deals with the earth as a whole, and some facts of astronomy; Part ii.—entitled "The Atmosphere"—also touches on light, heat, electricity, magnetism, and the distribution of animals; Part iii. treats of the ocean; and Part iv. of the land. The last part is by far the best from every point of view, and the treatment of the action of rivers on the land is quite beyond anything we have seen in other books of similar scope. This department of physical geography has received more attention in America than in Europe, and we are grateful to Prof. Tarr for the way he has handled it. It is unfortunate that the other parts do not rise to the same level. The illustrations, however, are all very good.

No doubt some terms are used in a different sense in this country and in America, *e.g.* physiography, which here is wider than physical geography, is there restricted to geomorphology. It appears that *zone* is held to signify simply a division, *e.g.* "there are three great zones of life . . . the ocean, the land, and the fresh water" (p. 165); and "in lieu of" (p. 27) is used where we would say "in view of." The term adulteration, on p. 33 ("nitrogen . . . acts as an adulterant to the active oxygen in a manner similar to the adulteration or weakening of a solution of salt when water is added to it"), is used evidently in the sense of dilution, and is not intended to convey any suggestion of fraudulent mixture. But, making allowance for differences of custom in the use of words, we have noted several cases of very slack or even careless definition. There is also a want of attention to the minutiæ of terminology which must be very puzzling to the teachers who use this book, if their mode of doing so is the same as that adopted by their brethren in this country. In a new edition these blemishes will doubtless disappear, and we point them out merely with that object. Such vague sentences as the following, on wind as the cause of waves, should also be revised: "If the wind continues, and especially if it freshens, the waves become higher, for the cause is increased because then there is more friction" (p. 206).

The occasional descriptions of instruments, *e.g.* the psychrometer, anemometer, and especially the deep-sea sounding-rod, are inadequate and sometimes misleading. On the current chart (p. 214) the important and very distinct Agulhas current is not named; and in the sketch-map of the distribution of volcanoes, on p. 355, the active volcanoes which have been definitely proved to exist in Central Asia and Central Africa are not shown.

H. R. M.

Arii e Italici. By G. Sergi. Pp. iv + 228. (Torino: Fratelli Bocca, 1898.)

PROF. SERGI may be congratulated on the lucid manner in which he describes the earliest inhabitants of Italy, and the effects produced by the various invasions of that country. From conclusions drawn from anthropological observations he leads us to believe that the Aryans first invaded Italy from the north-west, and established themselves on the banks of the river Po, terramara being found in that locality. These mixed with the Mediterranean race, and spread south-east, leaving the country around Genoa undisturbed; towards the end of the eighth century before the Christian era, the Etruscans landed on the banks of the Tiber and mixed with the inhabitants of Umbria. No satisfactory explanation of the foundation of Rome is offered.

Anthropological detail is restricted to skulls found in tombs; the method of description is that first introduced by the author, which is based upon the appearance of the skull viewed in *norma verticalis*.

The construction of terramara and lake dwellings, the various kinds of pottery and vases, are briefly described in the chapters dealing with archæology.

The origin of the Italian language and the anthropological evidence in favour of the suggestions of Schleicher, Lottner, &c., is carefully weighed.

It would assist the study of ethnology if the inhabitants of the other European countries were dealt with in as brief and scientific a manner as those of Italy have been by Sergi in "Arii e Italici."

Laboratory Practice for Beginners in Botany. By William A. Setchell, Ph.D., Professor of Botany in the University of California. Pp. xiv + 199. (New York: The Macmillan Co. London: Macmillan and Co., Ltd., 1897.)

THIS little book is, on the whole, admirably calculated to fulfil the intentions of its author. The young student is directed to observe simple and readily accessible objects, and his reasoning faculties are at the same time stimulated by an indication of the general principles which the selected examples are intended to illustrate. By the time he has worked through the book, a boy will have acquired a fair knowledge of the gross structure of plants—a knowledge quite as important as that of minute structure which he too often has never seen for himself, or of physiology which, when ignorant of chemistry and physics, he cannot understand.

Some of the suggestions to the teacher are excellent, but we can hardly praise the selection of literature suggested for his use. A teacher ought to know where to seek for the facts he may have temporarily mislaid; and if he really requires the aid Prof. Setchell is ready to render him in this respect, he is clearly unfit to teach.

"*On a Sunshine Holyday.*" By the Amateur Angler. Pp viii + 140. (London: Sampson Low, Marston, and Co., 1897.)

THE short—very short—papers collected in this booklet originally appeared in the *Fishing Gazette*. The author confesses that he is "well aware that from the standpoint of literature these papers possess no claim for a separate existence." He might also have added that, from a scientific point of view, there is even less justification for their publication.

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.*]

Abridged Long Division.

A Brief Method of dividing a given Number by a Divisor of the Form $(h.\ 10^n \pm k)$, *where at least* one *of the two numbers, h and k, is greater than* 1.

MY former paper on this subject, which appeared in NATURE for October 14, 1897, dealt only with the case where $h = 1$ and $k = 1$. It elicited, from other correspondents of NATURE, several interesting letters, which the editor kindly allowed me to see. One, from Mr. Alfred Sang, quotes Mons. L. Richard's "Sténarithmie," as containing my Rule for dividing by 11. Mons. Richard's book, which I had not previously met with, does certainly contain the rule, but the author has failed to see that the test, which this Method furnishes, for the correctness of the working, is absolutely *definite*. He says "La dernière différence, ou cette différence augmontée de 1, égalera le chiffre de gauche du nombre proposé." So ambiguous a test as this would of course be useless. But the "difference" he is speaking of is really the *last but one:* the very *last* will always (as I stated in my former paper) be equal to zero. Another correspondent, Mr. Otto Sonne, says that my Rules, both for 9 and for 11, are to be found in a school-book, by a Mr. Adolph Steen, which was published at Copenhagen in 1847. So I fear I must reduce my claim, from that of being the first to discover them, to that of being the first to publish them in English.

The Method, now to be described, is applicable to three distinct cases :—

(1) where $h > 1, k = 1$;
(2) where $h = 1, k > 1$;
(3) where $h > 1, k > 1$.

With certain limitations of the values of h, k, and n, this Method will be found to be a shorter and safer process than that of ordinary Long Division. These limitations are that neither h nor k should exceed 12, and that, when $k > 1$, n should not be less than 3 : outside these limits, it involves difficulties which make the ordinary process preferable.

In this Method, two distinct processes are required—one, for dealing with cases where $h > 1$, the other, for cases where $k > 1$. The former of these processes was, I believe, first discovered by myself, the latter by my nephew, Mr. Bertram J. Collingwood, who communicated to me his Method of dealing with Divisors of the form $(10^n - k)$.

In what follows, I shall represent 10 by t.

Mr. Collingwood's Method, for Divisors of the form $(t^n - k)$, may be enunciated as follows :—

"To divide a given Number by $(t^n - k)$, mark off from it a period of n digits, at the units-end, and under it write k-times what would be left of it if its last period were erased. If this number contains more than n digits, treat it in the same way; and so on, till a number is reached which does not contain more than n digits. Then add up. If the last period of the result, *plus* k-times whatever was carried out of it, in the adding-up, be less than the Divisor, it is the required Remainder ; and the rest of the result is the required Quotient. If it be not less, find what number of times it contains the Divisor, and add that number to the Quotient, and subtract that multiple of the Divisor from the Remainder."

For example, to divide 8678159248570315276 4092 by 9993 (*i.e.* by $t^4 - 7$), he would proceed thus :—

9993 ‖	867	8159	2485	7031	5276	| 4092
		6074	7114	7399	9220	6932
		4	2522	9803	1799	4540
			29	7660	8622	2593
				208	3626	0354
					1458	5382
					1	0206
						7
Quot.	868	4238	2153	2104	0004	‖ 4106 + 14 = 4120 Rem.

The new Method will be best explained by beginning with case (3) : it will be easily seen what changes have to be made in it when dealing with cases (1) and (2).

The Rule for case (3), when the sign is "−," may be enunciated thus :—

Mark off the Dividend, beginning at its units-end, in periods of n digits. If there be an overplus, at the left-hand end, less than h, do not mark it off, but reckon it and the next n digits as one period.

To set the sum, write the Divisor, followed by a double vertical : then the Dividend, divided into its periods by single verticals, with width allowed in each space for $(n + 2)$ digits. Below the Dividend draw a single line, and, further down, a double one, leaving a space between, in which to enter the Quotient, having its units-digit below that of the last period but one of the Dividend, and also the Remainder, having its units-digit below that of the last period of the Dividend. In this space, and in the space below the double line, draw verticals, corresponding to those in the Dividend ; and make the last in the upper space double, to separate the Quotient from the Remainder.

For example, if we had to divide 5984407103826 by 6997 (*i.e.* $7.\ t^3 - 3$), the sum, as set for working, would stand thus :—

6997 ‖	5984 |	407 |	103 |	826	
Quot.	|	|	‖		Rem.
	|	|	|		

To work the sum, divide the 1st period by h : enter its quotient in the 1st Column below the double line, and place its Remainder above the 2nd period, where it is to be regarded as *prefixed* to that period. To the 2nd period, with its prefix, add k-times the number in the 1st Column, and enter the result at the top of the 2nd Column. If this number *is not* less than the Divisor, find what number of times it contains the Divisor, and enter that number in the 1st Column, and k-times it in the 2nd ; and then draw a line below the 2nd Column, and add in this new item, deducting from the result t^n-times the number just entered in the 1st Column ; and then add up the 1st Column, entering the result in the Quotient. If the number at the top of the 2nd Column *is* less than the Divisor, the number in the 1st Column may be at once entered in the Quotient. The number entered in the Quotient, and the number at the foot of the 2nd Column, are the Quotient and Remainder that would result if the Dividend ended with its 2nd period. Now take the number at the foot of the 2nd Column as a new 1st period, and the 3rd period as a new 2nd period, and proceed as before.

The above example, worked according to this Rule, would stand thus :—

		6	5	3	
6997 ‖	5984 |	407 |	103 |	826	
Quot.	855 |	281 |	849 ‖	6373	Rem.
	854 |	8969 |	5946 |		
	1 |	3 |	849 |		
		1972 |			
		281 |			

the Mental Process being as follows :—

Divide the 5984 by 7, entering its Quotient, 854, in the 1st Column, and placing its Remainder, 6, above the 2nd period. Then add, to the 6407, 3-times the 854, entering the result in the 2nd Column, thus. "7 and 12, 19." Enter the 9, and carry the 1. "1 and 15, 16." Enter the 6, and carry the 1. "5 and 24, 29." Enter the 9, and carry the 2, which, added to the prefix 6, makes 8, which also you enter. Observing that this 8969 *is not* less than the Divisor, and that it contains the Divisor *once*, enter 1 in the 1st Column, and 3-times 1 in the 2nd, and then draw a line below, and add in this new item, remembering to deduct from the result 7-times t^3, *i.e.* 7000 : the result is 1972. Then add up the 1st column, as far as the double line, and enter the result, 855, in the Quotient. Now take the 1972 as a new 1st period, and the 3rd period, 103, as a new 2nd period, and proceed as before.

The Rule for case (3), when the sign is "+," may be deduced from the above Rule by simply changing the sign of k. This will, however, introduce a new phenomenon, which must be provided for by the following additional clause :—

When you add, to the 2nd period with its prefix, $(-k)$-times the number in the 1st Column, *i.e.* when you *subtract* k-times this number *from* the 2nd period with its prefix, it will sometimes happen that the subtrahend exceeds the minuend. In this case the subtraction will end with a *minus* digit, which may be indicated by an asterisk. Now find what number of Divisors must be added to the 2nd Column to cancel this *minus* digit, and enter that number, marked with an asterisk, in the 1st Column, and that multiple of the Divisor in the 2nd; and then draw a line below the 2nd Column, and add in this new item.

As an example, let us take a new Dividend, but retain the previous Divisor, changing the sign of k, so that it will become 7003 (*i.e.* $7.\ t^3+3$). The sum, as set for working, would stand thus:—

```
7003 || 6504 | 318 | 972 | 526
Quot.             |     ||       Rem.
        =========================
               |     |     |
```

After working, it would stand thus:—

```
                    1      4     5
7003 || 6504  |   318 |  972 |  526
Quot.   928   |   790 |  371 || 4413  Rem.
       ===============================
        929   | 2*531 | 2602 |
         1*   | 7 003 | ==== |
              | ----- |  371 |
              | 5 534 |
              | ===== |
              |   790 |
```

the Mental Process being as follows:—

Divide the 6504 by 7, and enter the Quotient, 929, in the 1st Column, and the Remainder, 1, above the 2nd period. Then subtract, from the 1318, 3-times the 929, entering the result in the 2nd Column, thus. "27 from 8 I ca'n't, but 27 from 28, 1." Enter the 1, and carry the borrowed 2. "8 from 1 I ca'n't, but 8 from 11, 3." Enter the 3, and carry the borrowed 1. "28 from 3 I ca'n't, but 28 from 33, 5." Enter the 5, and carry the borrowed 3. "3 from 1, *minus* 2." Enter it, with an asterisk. Observing that, to cancel this *minus* 2, it will suffice to add *once* the Divisor, enter a (−1) in the 1st Column, and 7003 in the 2nd; and then draw a line below the 2nd Column, and add in this new item: the result is 5534. Then add up the 1st Column, and enter the result, 928, in the Quotient. Now take the 5534 as a new 1st period, and the 3rd period, 972, as a new 2nd period, and proceed as before.

The Rules for case (2) may be derived, from the above, by making $k=1$; and those for case (3) by making $h=1$. I will give worked examples of these; but it will not be necessary to give the Mental Processes.

By making $k=1$, we get Divisors of the form $(h.t^n \pm 1)$: let us take $(11t^4 - 1)$ and $(6t^5 + 1)$.

```
                          9        10       4
109999 || 107523 |     8168 |     9662 |  0985
Quot.      9774  |     9813 |     0861 | 41846  Rem.
          ===========================================
           9774  |   107942 |   119474 |
                 |   ====== |        1 |
                 |     9812 |   ------ |
                 |        1 |     9475 |
                 |          |   ====== |
                 |          |     ·861 |

                  3                 3
600001 || 7239 | 51798  | 2 6004 | 13825
Quot.     1206 | 58431  | 9 4595 || 219230  Rem.
         ========================================
               | 350592 | 4*7572 |
               | ====== | 60 0001|
               |  58432 | -------|
               |     1* | 56 7573|
               |        | =======|
               |        | 9 4595 |
```

In this last example, there is no need to enter the Quotient, produced by dividing the 7239 by 7, in the 1st Column: we easily foresee that the number at the top of the 2nd Column *will be* less than the Divisor, so that there will be no new item in the 1st: hence we at once enter the 1206 in the Quotient.

By making $h = 1$, we get Divisors of the form $(t^n \pm k)$: let us take $(t^4 - 7)$ and (t^5+12).

```
9993 || 867 |  8159 |  2485 |  7031 |  5276 | 4092
Quot.   868 |  4238 |  2153 |  2104 |  0004 | 4120  Rem.
       ==============================================
        867 | 14228 | 32130 | 22088 | 19990 |
          1 |     7 |    21 |    14 |    14 |
            | ----- | ----- | ----- | ----- |
            |  4235 |  2151 |  2102 |     4 |
            |     3 |     2 |     2 |

100012 || 7185 | 6 2039  |  10327 | 53118
          7184 | 7 5822  |  00463 | 47562
         =====================================
          7185 | 3*5819  | 9*00355 |
            1* | 10 0012 | 9 00108 |
               | ------- | ------- |
               | 7 5831  |     463 |
               |      9* |
```

The first of these two sums is the one I gave to illustrate Mr. Collingwood's Method of working with Divisors of the form $(t^n - k)$.

It may interest the Reader to see the 3 Methods of working the above example—ordinary Division, Mr. Collingwood's Method, and my version of it—compared as to the amount of labour which each entails in the working:—

	Ordinary Division.	Mr. C.'s Method.	My version of it.
Digits written:	202	82	44
Additions, or Subtractions:	204	97	25
Multiplications:	0	70	22

I am assuming that any one, working this example by ordinary Division, would begin by making a Table of Multiples of 9993, for reference: so that he would have *no* Multiplications to do. Still, the great number of digits he would have to write, and of Additions and Subtractions he would have to do, involving a far greater risk of error than either of the other Methods, would quite outweigh this advantage.

By whatever process a Question in Long Division has been worked, it is very desirable to be able to test, easily and quickly, the correctness of the Answer. The ordinary test is to multiply together the Divisor and Quotient, add the Remainder, and observe whether these together make up the given Number, as they ought to do.

Thus, if N be the given number, D the given Divisor, Q the Quotient, and R the Remainder, we ought to have

$$N = D.Q + R.$$

This test is specially easy to apply, when $D = (h.t^n \pm k)$; for then we ought to have

$$N = (h.t^n \pm k).\ Q + R;$$
$$= (hQ.t^n + R) \pm kQ.$$

Now $hQ.t^n$ may be found by multiplying Q by h, and tacking on n ciphers. Hence $(hQ.t^n + R)$ may be found by making R occupy the place of the n ciphers. If R contains less than n digits it must have ciphers prefixed; if more, the overplus must be carried on into the next period, and added to hQ.

Having found our "Test," viz. $(hQ.t^n + R)$, we can write it on a separate slip of paper, and place it below the working of the example, so as to come vertically below N, which is at the top. When the sign in D is '−,' we must add kQ to N, and see if the result $= T$; when it is '+,' we must add kQ to T, and see if the result $= N$.

Now it has been already pointed out that when, in the new Method, the 1st and 2nd Columns have been worked, the 1st period of the Quotient and the number at the foot of the 2nd Column are the Quotient and Remainder that would result if the Dividend ended with its second period. Hence the Test can be at once applied, before dealing with the 3rd Column. This constitutes a very important new feature in my version of Mr. Collingwood's Method. Every two adjacent columns contain a separate Division-sum, which can be tested *by itself*. Hence, in working my Method, as soon as I have entered the 1st period of the Quotient, I can test it, and, if I have made any mistake, I can correct it. But the hapless computator, who has spent, say, an hour, in working some gigantic sum in Long Division—

whether by the ordinary process or by Mr. Collingwood's Method—and who has chanced to get a figure wrong at the very outset, which makes every subsequent figure wrong, has no warning of the fatal error till he has worked out the whole thing "to the bitter end," and has begun to test his Answer. Whereas, if working by *my* Method, he would have been warned of his mistake almost as soon as he made it, and would have been able to set it right before going any further.

As an aid to the Reader, I will give the Mental Process in full, for the 2nd and 3rd Columns of the first of the examples worked above.

The Divisor is 6997 (where $h = 7$, $k = 3$). Here you are supposed to have just entered the 281 in the Quotient. The Dividend, for these 2 Columns, is 1972 | 103; the Quotient is 281, and the Remainder 5946. The Test is $hQ.t^n + R$, (*i.e.* $7 \times 281000 + 5946$), the Mental Process being as follows. You write, on a separate slip of paper, the last 3 digits of R, viz. 946, and carry the 5 into the next period, adding it to the 7 × 281: thus. "5 and 7, 12." Enter the 2, and carry the 1. "1 and 56, 57." Enter the 7, and carry the 5. "5 and 14, 19." Enter it. Having got your Test, try whether $(N + kQ)$ is equal to it. This you compute, comparing it with your Test, digit by digit, as you go on, thus. "3 and 3, 6." Observe it in the Test. "0 and 24, 24." Observe the 4, and carry the 2. "3 and 6, 9." Observe it. "1972 and 0, 1972." Observe it. The Test is satisfied.

6	5
407	103
281	
8969	5946
3	
1972	
281	
Test 1972	946

For Divisors of the form $(t^n \pm k)$ there is no need to write out the Test: the numbers, which compose it, already occur in the working, and may be used as they stand.

CHARLES L. DODGSON.

Ch. Ch., Oxford, December 21, 1897.

Optical Illusions produced by Observation of Rotating Spirals.

IT is well known that if a spiral, such as represented in the figure, rotating in the opposite direction to the movement of the hands of a clock, be observed for some minutes, an impression of circles arising at the centre and disappearing at the periphery is produced; after protracted observation, on looking at printed matter or a person's face, the letters appear to move towards the centre while the face appears to become smaller and recede. If the spiral be rotated in the opposite direction, the circles

appear to be passing towards the centre, in which case the after-effect is more marked and lasts longer, the letters naturally pass centrifugally while the face apparently increases in size.

The latter effect in my own observations has sometimes continued for fifty seconds, while the former never for more than twenty seconds. This effect is practically the same as the "waterfall phenomenon," in which case the banks appear to move upwards after gazing for some time at the falling water.

What I wish to draw attention to in this note is the effect which may be observed on closing the eyes after watching a well-illuminated rotating spiral.

If the direction of rotation has produced the impression of centripetally travelling rings, a star composed of radial lines consisting of small granular patches of light passing centrifugally will be noted for a second or two after closing the eyes. The granules pass centripetally if the direction of rotation be reversed. The star will appear symmetrical if the spiral be viewed normally, but if sideways the lines composing it will be curved and the star distorted: to some observers the centre of the star always appears to be further distant than the periphery. I have not been able to find any difference in time of duration of this after-image on rotating the spiral in the two directions.

The colour of the granules is always yellowish, whatever be the colour of the spiral and background. It is interesting to note that, as a rule, after-images of central production can be prophesied on psychological reasoning; while in the above case no one to my knowledge has been able to foretell the appearance of the star, and therefore I am inclined to think that the effect is retinal.

O. F. F. GRÜNBAUM.

Poisonous Koda Millet.

THERE have been several well-ascertained examples of poisoning from diseased or improperly-prepared *Koda* millet (*Paspalum scrobiculatum*) during the past year in India. Owing to the prevailing scarcity of the usual food-grains, it is probable that *Koda* millet has been extensively sold and eaten in localities where its use is ordinarily unknown.

I hoped to undertake an investigation myself into this matter, which is one of great importance both from the hygienic and economic points of view. After consultation, however, with Surgeon-Major van Geyzel, chemical examiner to the Government of Madras, I have decided that any investigation worthy of the name would occupy far more time than I have to give to it. I therefore write to you with a view to eliciting the help of some worker in Britain or elsewhere who has the necessary leisure and facilities for work of this sort. I have samples of the grain, husked and unhusked, from different localities, and can supply the necessary references to the literature of the subject. The investigation, I take it, would have to be of a chemico-biological nature, and would be most appropriate, say, for a thesis, or in connection with some fellowship. I hope that some one who can carry the work right through, and will ascertain the exact source and constitution of the poison (? a volatile alkaloid), will write to me at the address given below. In another ten years, perhaps, there will be some attempt to provide the men and the facilities for such work, even in India, when the Victoria Institute is an accomplished fact.

A. E. GRANT.

Hygiene Laboratory, Medical College, Madras.

Hermaphroditism in the Herring.

I WISH, with your permission, to record a singular "freak of nature" and, at the same time, to ask whether any similar observation has been made by others.

Some fresh herrings were served us here last evening for dinner, and among them was one which, on being opened, disclosed a roe, half of which was "hard" and the other half "soft." The ova and milt were respectively quite normal in appearance (and flavour), and melted imperceptibly one into the other about midway in the length of the roe, which was, itself, in an obviously natural and undisturbed condition.

Sea Lawn, Torquay, January 12.

DAN. PIDGEON.

A Bright Meteor.

ON Sunday night (December 12), at about 8.15, I witnessed the appearance of a magnificent meteor which seemed to travel from the south-east in the direction of Ursa Major. It broke up into a number of fiery balls of most brilliant colours. The atmosphere was clear and frosty and the moon very bright, but it was for the moment quite eclipsed by the brilliancy of this striking meteoric display. This may be the same phenomenon as that referred to in NATURE for January 6 (see page 228). I did not hear any sound like thunder at the time.

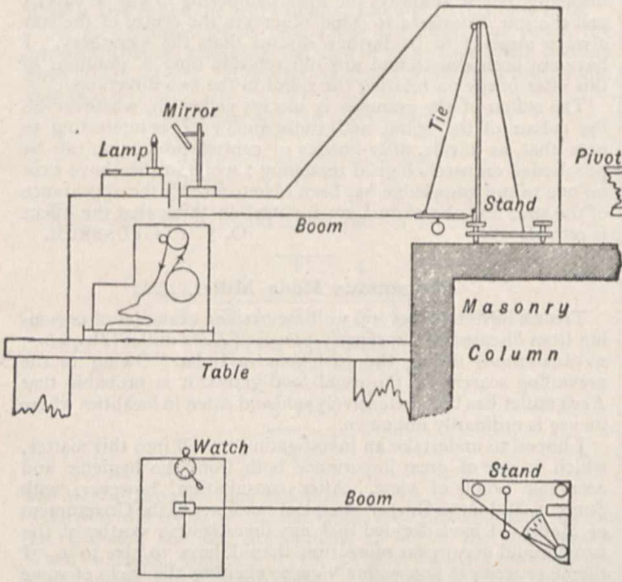
SUSANNA LEHMANN.

Wales Lodge, Wales, Sheffield, January 16.

RECENT SEISMOLOGY.[1]

II.—UNFELT MOVEMENTS OF THE EARTH'S CRUST.

THE records obtained from seismographs often showed, as we have already explained, preliminary vibrations performed with a rapidity which has even reached fifteen complete back and forth movements per second, a shock or shocks, and lastly a number of irregular jolts or



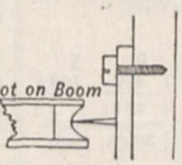


FIG. 7.—Type of instrument adopted by the Seismological Investigation Committee of the British Association, and established at many stations round the world. (Milne.)

undulations which died away with an increasing period. What seismologists had captured was what they could feel, and they were left to speculate as to what came at either extremity of the seismic spectrum. It seemed tolerably certain that if instruments were constructed capable of responding to exceedingly rapid but minute elastic vibrations, then a seismogram might show the movements preceding but forming portions of the preliminary vibrations. These would accompany the sound waves which in rocky districts so commonly outrace movements of a more pronounced character. These sound phenomena, which never extend far beyond an epifocal area, are in certain districts isolated phenomena which frequently recur. Without calling up the "spooks of Ballechin," or the Ghost of Long Wittenham, which on New Year's Eve rapped on the walls of many houses, in two instances we are assured that they have been sufficient to explain noises which had been regarded as supernatural, and it is not unlikely that the fully-equipped ghost hunter may be the discoverer of new paths in seismic science. When a volcano explodes, the resultant vibrations to which ordinary seismographs or ourselves are sensible, seldom reach to any great distance; but is it not possible that elastic tremors, the result of a powerful impulse, may even reach and be focussed at the antipodes of their origin? In the Perry-tromometer we have an apparatus which will automatically record elastic vibrations of the order here considered, but up to the present we are without the observer who is able to isolate himself at a site suitable for its installation. In the Isle of Wight the writer found that this instrument recorded the firing of cannon at a distance of six miles, the movements of trains at a distance of nearly one mile, the rumbling of carriages at the distance of a quarter of a mile, whilst it kept an excellent tally of the back and forth journeys of eleven gravel carts worked by a neighbouring contractor.

Investigations on the other end of the seismic spectrum have been more successful, and we now know that waves which have a period of one or two seconds within the area where they are appreciable to the senses, after these have radiated to great distances, for example over or through a quadrant of the earth, their period may exceed twenty seconds. In consequence of the slowness of the movements, together with the flatness of the waves, which are probably miles in length with heights measured by a few inches, every city in the world is often rocked slowly to and fro, and yet to the unaided senses motion is imperceptible.

A form of instrument used by the writer to record unfelt earthquakes, diurnal waves, tremors and other movements is shown in Fig. 7. On the outer end of the boom of the pendulum there is a small aluminium plate in which there is a slit. This is free to float to the right or left over a slit in the lid of a box in which clockwork drives a band of bromide paper. Light from a lamp passing through the two crossed slits reaches the paper as a point, and gives a line with extremely fine definition (see Fig. 8, under the words September 21). At each half-hour the minute hand of a watch crosses one end of the slit, and by eclipsing the light gives the hour marks shown in Fig. 8.

In the photograms of these unfelt earthquakes we see that the duration of the preliminary tremors is apparently connected with the distance the disturbance has travelled, and in this way a record has impressed upon it what is partially equivalent to the post-mark of its origin. For example, a disturbance originating in Japan would at a distance of, say, 200 km., be heralded by tremors which an ordinary seismograph would show to have a duration of ten or twenty seconds. A seismogram of the same shock taken in Europe shows that the same movements have a duration of about half an hour. The maxima phases of movements, which may be waves of distortion modified by gravity, travel at approximately

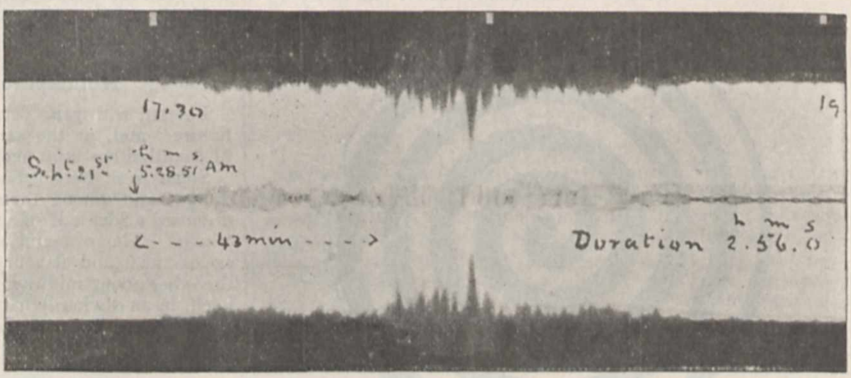


FIG. 8.—This earthquake of September 21, 1897, as recorded in the Isle of Wight, shows preliminary tremors of about 43 minutes, which indicate an origin at a distance of 112°, say, east of Borneo. It disturbed magnetographs in Batavia. A similar earthquake ten hours earlier is not known to have done so. (Milne.)

[1] Continued from p. 249.

the same rate of 2 or 3 km. per second over paths which are long or short. The preliminary vibrations, in all likelihood representing waves of compression, appear to have velocities of propagation closely related to the length of the path as measured on an arc over or across which they have been propagated. Such figures as we have, which are open to correction after observations have been extended, are easily remembered. Starting with a velocity of 2 km. per second for a path of 2000 km., then for a path of 4000 km. the velocity would be 4 km. per second, from Japan to England, or 9000 km., the velocity would be 9 km. per second; whilst, if we may carry conclusions beyond the limits of observation, we may imagine that the velocity of propagation between an origin and its antipodes may be 18 km. per second. As Mr. J. Larmor pointed out, if our records are correct, then outside our first 2000 km. coseismal, great disturbances will be recorded at all points on the surface of the world at approximately the same instant. Undoubtedly velocities of 9 and 10 km. per second have been noted, which indicate that the preliminary vibrations, at least, can not have been transmitted round the heterogeneous and broken materials constituting the earth's crust, but rather, that the movements have passed along direct, or by refraction along curvilinear paths *through* the interior of our earth. This fact, taken in conjunction with the fact that velocities of transmission increase with an increase in the length of the wave path, and that at any given station two sets of vibration separated by a time interval proportional to the difference in the great circle distances between an epicentre and the point of observation have not been observed, tend to strengthen this same view.

Rules connected with the transmission of preliminary tremors which apparently promise to throw new light on the physical condition of the interior of the earth are—

(1) The velocity in kilometres per second with which these movements are propagated is equal to one-quarter of the square root of the mean depth of the chord or path (in kilometres) along which we may suppose they travelled.

(2) The duration of preliminary tremors, or the interval of time expressed in minutes by which they outrace the longer period waves (as shown on a seismogram), equals the square root of the mean depth of the supposed wave path expressed in kilometres.

These rules, taken in conjunction with a map showing the surface configuration of the globe, enable an individual observer not only to locate an origin but also to determine the time at which an earthquake originated.

Inasmuch as a Committee of the British Association have lent their weight to the establishment of a number of horizontal pendulums at various observatories around the world, within the next few years it is likely that our present knowledge of the seismic breathings of the earth's crust will be placed on a more extended and accurate basis than that on which it at present rests; and, amongst other things, we shall have accumulated new facts bearing upon the effective rigidity of our planet, which is evidently greater than that usually assumed.

The practical outcome of this work is already many-sided. Observers at magnetic observatories, like those at Kew, Potsdam and Batavia, are now aware that greater or less disturbances in the uniformity of their records sometimes accompany unfelt earth waves. Because the earth waves do not always leave a record of their occurrence, whilst there are magnetographs of the Kew type, as, for example, at Greenwich, Falmouth and Stonyhurst, which, so far as I can learn, are but very rarely disturbed, we can not say with certainty that the movements of magnetometers are altogether the effect of mechanical disturbance. At about 5 a.m. on September 21, very marked movements were recorded by the magnetographs in Batavia, evidently the result of a movement recorded in the Isle of Wight (see Fig. 8). Because the preliminary tremors have a duration of forty-three minutes, the distance of their origin from the south of England is probably about 112°. This, together with the fact that on this date a "slight tremor" was felt along the coast of North Borneo, makes it tolerably certain that the origin of this convulsion was one or two hundred miles from that island. Strange to say, at 7 p.m. on the previous evening a disturbance, in all its main features identical with the one here illustrated, is also to be seen on the Isle of Wight seismograms, from which it may be inferred that we have the records of two earthquakes from the same origin.

Assuming this to be the case then, so far as we can judge from information received from Batavia, it was only the second of these unfelt motions that caused disturbances in the magnetographs at that place. Not only are magnetographs affected at the time when huge earth waves slowly move the areas on which they are situated, but in Japan similar instruments situated near to an earthquake centrum have been perturbed some days before the occurrence of a world-shaking shock. Then, again, there are the remarkable secular changes in declination and dip observed between 1880 and 1885, at several eastern stations, respecting which Captain E. W. Creak, F.R.S., gives the following notes:—

Bombay.—Until 1883-85 the needle was moving eastwards. It then stopped, since which it has been moving westwards at an increasing rate. In 1881 there was a sudden change in the dip, and the needle is now going down.

Hong Kong.—Until 1875 the needle was moving eastwards. Then there was a rest until 1880, when it turned westwards. The dip was upwards until about 1880, since which it has turned downwards.

Batavia.—Until 1884 the needle was moving eastwards, when it became stationary. It is now moving westwards. The dip was moderately upwards until 1881, but it has now greatly increased.

When it is remembered that these remarkable changes took place about the time of large earthquakes in Japan, as, for example, that which led to the inauguration of the Seismological Society in 1880, the Krakatoa eruption of 1883, and that the illustrations of more immediate possible connections between seismic and magnetic phenomena may be multiplied, we recognise that the seismic survey of the world may not only throw new light upon its physical condition, but also, perhaps, it may lead to inferences respecting gravitational rearrangements of external materials and internal magmas. The sites of these, at present, hypothetical hypogenic changes we should expect to find in districts where secular movements and superficial loading, due to sedimentation, are most pronounced. Because earthquakes are apparently the results of critical conditions in these processes, the records from horizontal pendulums tell us that the sites we search for are to be found submerged beneath deep water at or near the base of steeply sloping continental areas. The enormous size of the superficial displacements which accompany certain of these suboceanic changes is indicated by the creation of sea-waves, which have often agitated the whole of the Pacific for a period of one or two days; and if these rearrangements of material on the bed of an ocean are related to changes in the state of stress or accelerations in the movement of an internal *quasi* rigid matter influenced by continental load, we see in the operations which culminate as earthquakes, causes which should, at least, have a local magnetic influence.

Captain Creak, writing on "the general bearing of magnetic observations," in *Science Progress*, April 1896, says: "It may be remarked in passing that a remarkable alteration in the amount of secular change has been noticed in the declination and inclination at the following observatories: Bombay, Batavia and Hong Kong, about the period of the eruption of Krakatoa in 1883. This may be only a coincidence, but may it not also point to the possibility that the changes below the surface of the earth which culminated in that mighty explosion, and may still be at work, have had and continues to have magnetic effects which are recorded by the needles at these observatories?" (See also "The Volcanoes of Japan," by J. Milne, *Trans. Seis. Soc.*, vol. ix. part 2, p. 178, 1886.)

The seismograms of unfelt earthquakes tell the student of dynamical geology that certain activities to which he devotes attention are more pronounced beneath the ocean than they are on land, whilst the location of the origins from which these movements proceed indicate to the cable engineer districts to be avoided.

If we except the action of waves, the borings of teredo, and other influences resulting in cable destruction in shallow water, submarine earthquakes and their accompanying land-slides are responsible for very many interruptions of international communication. This form of destruction is particularly marked along the west coast of South America, and it is not unknown in the Atlantic, the Mediterranean, and the Indian Ocean. In 1888 a submarine earthquake cut off the Australian colonies from the outer world for a period of nineteen days, and the apprehension that the isolation was an act of war led to the calling out of military and naval reserves. Had Australia been provided with a single instrument to record the unfelt movements, which must have reached it, anxiety and expense would have been avoided.

From an official notification I learn that two West Indian cables gave way on December 31, 1897. I am not certain, but the Isle of Wight seismograms indicate that the failures probably took place at 11.30 a.m.. G.M.T., on December 29.

One immediate use of a seismogram is that it tells us whenever a large earthquake occurs, and gives a locus for its origin, which information has already on more than one occasion been the means of correcting, confirming, extending and disproving ordinary telegraphic information. Sometimes messages have reached us which have contained errors in their dates of one or two days, others have been grossly exaggerated accounts of small disturbances, whilst a third group, inasmuch as they create feelings of anxiety without reason are the most reprehensible of all, have, if we except the feelings of satisfaction they gave to their senders, been without foundation. In all these instances the seismogram or its absence has assisted in the interpretation of the telegram.

Up to the present seismology has found foster-parents in the meteorologist and the geologist—the one collecting facts about earthquakes, whilst the other wrote about them. Because it has grown to unwieldy proportions, it seems time that the child should try and stand alone and become guardian of its own discoveries. In "diurnal waves" and "tremors" we see Romulus and Remus seeking a mother, and although they are not of the *genus terræmotus*, because they partially, at least, represent earth-movements, Seismology has become their guardian.

By a diurnal wave we mean a slow tilting which takes place in piers and buildings, especially on fine days, for six or ten hours rapidly in one direction, and during the remainder of the twenty-four hours, but more slowly, in an opposite direction (Fig. 9). This movement may be found underground where changes in temperature are insignificant. The actual causes of these movements are at present matters for speculation, but the theory which best explains the phenomena they present (as for example, that on opposite sides of a valley, it has been observed that movements take place simultaneously but in opposite direction), is that these changes in the vertical are due to differential changes on opposite sides of a station in the loads removed during the day, or acquired during the night by evaporation and condensation of aqueous vapours. During the day it is assumed that, by ordinary evaporation and the transpiration of plants, the bottom of a valley loses more weight than its comparatively drier and less clothed sides.

During a hot day the stream at the bottom of such a valley should discharge fewer and fewer gallons of water, whilst the valley bed, because it is relieved of load, should rise. For the remaining fourteen or eighteen hours, because aqueous vapour is condensed beneath the chilled surface of the ground, or as it emerges from the ground on plant and other surfaces, the stream in the bottom of the valley would increase its flow, and relatively to the sides and bounding ridges of the valley, where we may suppose the conditions for condensation to be less favourable, the lower parts of the same would become heavier and thereby sink. As to whether this concertina-like opening and shutting of valleys representing changes of slope of one or two inches in three or four miles in the average inclination of their boundaries really exists, all we can say is that instruments have given indications that can be explained on such a supposition. The fact that the piers carrying some of the instruments have risen from the chalk, and not from the alluvium, and that during long-continued wet weather there is continuous creeping of a horizontal pendulum towards the heavily loaded valley bottom, and that the

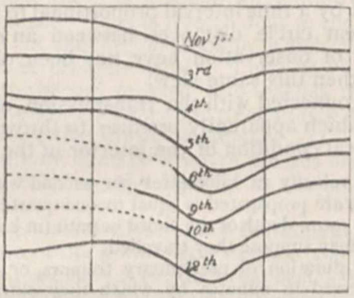


FIG. 9.—Diurnal waves at Shide, I.W., 1 mm. deflection = tilt 0"·5. (Milne.)

direction of greatest movement at the time of an earthquake appears to be at right angles to the dip, from which it may be inferred that valleys due to geotectonic folding exhibit a certain flexibility, tend to support the idea that the observed diurnal movements are due to actual movements of more or less extensive areas. No doubt some portion of the observed effects may be directly attributable to solar radiation.

In searching for an explanation of diurnal, annual and other changes in the vertical, the seismologist has had to consult the records of the astronomer, the observations of the hydraulic engineer, the botanist, and the farmer, and to experiment and search for information in domains far removed from anything supposed to be connected with movements of the ground.

Have changes in the vertical been most pronounced in regions where it may be supposed that orogenic changes are yet in progress? How far are changes in the vertical effected by seasonal and daily changes in temperature, by fluctuations in barometrical pressure, by the rise and fall of tide upon a coast line, and by lunar attraction? What tilting effects would result if the seasonal growth and partial removal of foliage and herbage on one side of an observing station were greater than those upon the opposite side? What is the rate at which alluvium may creep down the face of steep slopes, carrying with it perhaps a forest, and what is its cause? What is the amount of moisture transpired by various plants per day, per month, and per season? Do not some plants and trees absorb rather than transpire moisture from the atmosphere at certain seasons? What is the transpiration of plants at night as compared with that during the day? Is there such a thing as subsurface dew, and what is its amount? What is the function of stones in arable land as fertilisers? What do we know respecting the diurnal flow in rivers, and the semi-diurnal rise and fall in certain wells? Will a squad of men walking up to the walls of an observatory, or the load equal to the weight of an average man at the base of a pier in the same produce any appreciable change of level on the top of such a pier? Are high mountains measurably deflected by wind pressure? In the workings of a mine beneath the sea what data do we possess respecting deflections in the roof due to the rise and fall of a superincumbent tide? What is the natural period of vibration of a chimney or building of given structure?

These are examples of the varied questions which have been placed before the seismologist, and to most of which, as the result of experiment and observation, he is able to give fairly definite replies. Although in a few instances these replies may not have given the assistance to his investigations expected, a consolation remains that

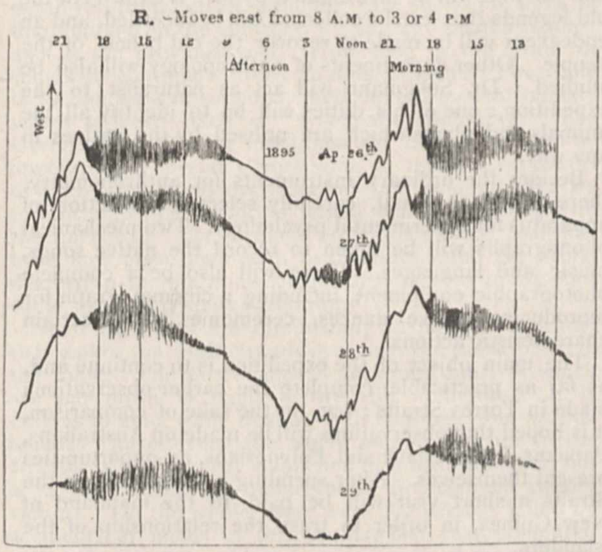


FIG. 10.—Irregular diurnal waves in Japan, always showing tremors from 9 p.m. to 6 a.m. (Milne.)

they have been of considerable value to workers in other fields.

Perhaps the greatest trouble against which the working seismologist has had to fight have been the ubiquitous, so-called, "earth" tremors (see Fig. 10). Sometimes the apparatus will swing, and perform for hours or days various irregular, and sometimes marvellously regular back and forth movements, with the result that all traces of important phenomena have been eclipsed (Fig. 11). Not only do "tremors" affect finely constructed horizontal pendulums, but in all probability they affect magnetographs, the delicate balance of the assayer, and accelerate or retard the swing of pendulums. They are frequent in winter, at night, and whenever the observatory in which they are recorded is crossed by a steep barometric gradient. They are particularly noticeable with a frost and a falling thermometer. With a howling gale, and even during a typhoon, when buildings shake and shudder, they are as likely to be absent as present (Fig. 12).

Because a light horizontal pendulum is more disturbed than one that is heavy, and that we observe at one station tremors are marked, whilst they are only shown feebly, or are entirely absent at another station a few yards distant, it is evident that we are dealing with movements due to currents of air, rather than with movements due to tremors in the ground. Although we fully recognise, as stated at the commencement of this article, that there are microseismic movements in the earth, it is very doubtful whether in the thousands of observations carried out day and night, especially in the Italian peninsula, these movements have been differentiated from those which are the result of atmospheric

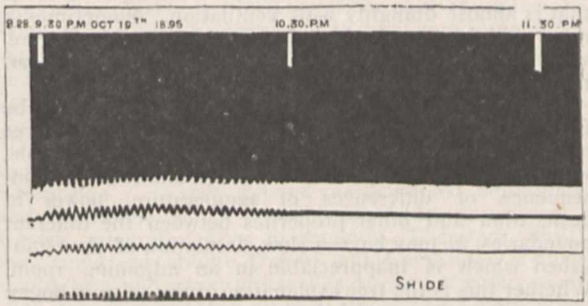


FIG. 11.—Pulsations or very regular tremors with periods of 2 or 3 minutes. The recording pendulum has always a natural period of about 15 seconds. (Milne.)

circulation. Simply opening or closing the door of a case covering an instrument will sometimes start or stop a so-called tremor storm. The fact that placing a tray of calcium chloride inside one of these cases will cause very large and continuous movements which cease on its withdrawal, indicates that air currents are partly due to the manner in which an atmosphere becomes dry or moist. In the search for the originating cause of tremors

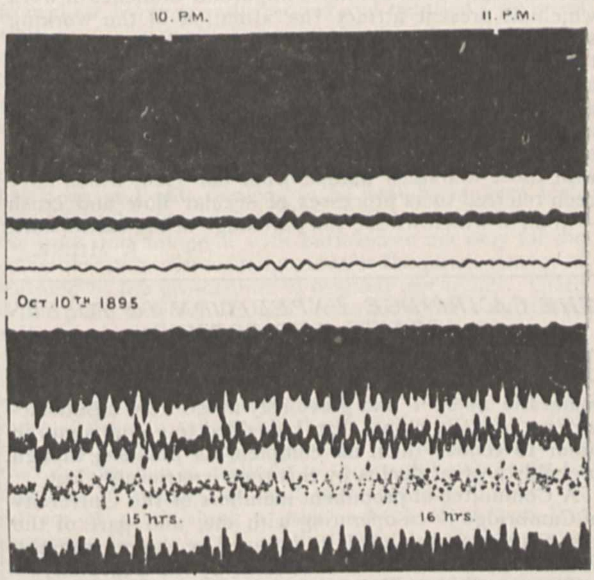


FIG. 12.—Commencement of a tremor storm at 10 p.m. with movements having a period of several minutes. At 15 and 16 hours they are very irregular, whilst later the band is blackened by these movements. (Milne.)

which has extended over a period of nearly thirty years, we see an excellent example of long-continued and patient work which, so far as the advancement of seismology is concerned, appears at first sight to have terminated in a fiasco. Now, however, we know that we have to distinguish between movements caused by the atmosphere and those coming from the earth. We see a reason why at particular observatories magnetographs are sometimes on the swing. The reason why, under certain conditions, the assayer's balance may sometimes oscillate and quickly change its zero is understood. Possibly these air currents may indirectly have led to the abandonment of the Cavendish experiment at Cambridge, and explain why a very well-constructed horizontal pendulum is never quite at rest.

One very important piece of knowledge for the seismologist lies in the fact that these so-called tremors can be stopped by using covering cases through which air can circulate, but above all by working in a room that is almost draughty with ventilation. Sometimes a room will be found which it seems impossible to cure, whilst in the adjoining one, for reasons not quite clear, the same instrument will always remain at rest.

It seems as if there existed in rooms which may be fairly similar in appearance slight physical differences of the walls, the floors and ceilings, as, for example, with regard to dampness; so that in one room, in consequence of differences of temperature, power of desiccation and other properties between the different boundaries, we may have a slow circulation of air established which is inappreciable in an adjoining room. Whether this is the true explanation of the seismic bogey remains for more careful demonstration, but already the writer has learned that with draughty surroundings an instrument will remain at rest, whilst when this condition is neglected, what is apparently a slow and steady circulation of the atmosphere will cause motion. We yet wish to know why these troublesome visitors appear with such regularity at certain hours and seasons (see Fig. 9). One result of what we have learned is that now hundreds of feet of bromide paper have been saved from blackening, and unfelt earthquakes, which otherwise would have been eclipsed, have been clearly recorded.

In the above few notes all that is attempted is to give a scanty outline of the more important branches of work which at present attract the attention of the working seismologist. Other investigations which it is desirable to make relate to the irregular changes in level which are completed in a few minutes or several days, and above all those grander movements, the results of which are exhibited on the surface of our earth in the formation of continental domes and mountain ranges, together with those activities hidden from our view, which have been referred to as processes of secular flow and crush—in all of which we see the parentage of the earthquake.

J. MILNE.

THE CAMBRIDGE EXPEDITION TO TORRES STRAITS AND BORNEO.

DURING the preparation of a monograph on the anthropology of the Torres Straits islanders, I found the notes I had previously made were unsatisfactory on so many points that I decided to go out again in order to render them as complete as possible, though probably a great deal is by this time irretrievably lost.

A Committee of prominent members of the University of Cambridge is co-operating with me, and part of the cost of the expedition will be defrayed by a grant from the Worts' Fund, which is administered by the University.

The expedition will be almost entirely anthropological in character, but the land flora and fauna will not be neglected, and certain geographical observations will also be made.

The other members of the expedition are Dr. W. McDougall, Fellow of St. John's College, Cambridge, and of St. Thomas's Hospital, London; Dr. C. S. Myers, Caius College, Cambridge, and St. Bartholomew's Hospital, London; Mr. S. H. Ray, Dr. W. H. R. Rivers, St. John's College, Cambridge, Lecturer on Experimental Psychology at Cambridge and at University College, London; Dr. C. G. Seligmann, of St. Thomas's Hospital; and Mr. A. Wilkin, of King's College, Cambridge.

The work of the expedition will be distributed as follows:—I shall be responsible for the observations on the physical characters of the natives; their language and phonology will be studied by Mr. Ray. Mr. Ray, who has a world-wide reputation as an authority on the languages of Oceania generally, has already made a very careful study of the languages of Torres Straits ("A Study of the Languages of Torres Straits, with Vocabularies and Grammatical Notes," *Proc. Roy. Irish Acad.* (3), ii., 1893, p. 463; iv., 1897, p. 119). Drs. Rivers, McDougall and Myers will initiate a new departure in practical anthropology by studying comparative experimental psychology in the field. They will test the senses and sensibility of the natives as far as it will be possible under the local conditions, and make whatever observations they can on the mental processes of the natives. Dr. Myers will also pay especial attention to native music, and I shall continue my researches on the decorative art of British New Guinea.

The hygienic and medical aspects of anthropology will be studied by the four qualified medical men. The sociology of the natives, including such subjects as relationships, ownership, land tenure, descent of property, and the like, will be investigated by Mr. Wilkin. All the old legends that can be collected will be recorded, and an endeavour will be made to recover the old beliefs of the people. Other departments of anthropology will also be studied. Dr. Seligmann will act as naturalist to the expedition; one of his duties will be to identify all the animals and plants which are utilised by the natives in any way.

Besides the ordinary instruments for anthropometry, there will be a small, carefully selected, collection of apparatus for experimental psychology. Two mechanical phonographs will be taken to record the native songs, music and languages. There will also be a complete photographic equipment, including a cinematograph for reproducing native dances, ceremonies, and certain characteristic actions.

The main object of the expedition is to continue and, as far as practicable, complete the earlier observations made in Torres Straits; but, for the sake of comparison, it is hoped that observations will be made on Australians, Papuans, Melanesians and Polynesians, as opportunities present themselves. After spending a few months in the Straits a short visit will be paid to the mainland of New Guinea, in order to trace the relationship of the islanders.

Some of the party will then have to return home; but the remainder have accepted a very generous and enthusiastic invitation to visit Mr. C. Hose, the Chief Magistrate of the Baram District of the Raj of Sarawak. Mr. Hose, who is a Cambridge man (Jesus College), is a keen naturalist and has a very wide knowledge of the natives and their languages, and has a warm sympathy for the people themselves; consequently the expedition will have exceptional facilities for seeing something of the inland tribes of Borneo, and interesting comparisons may be expected between the different races which the expedition will have under observation.

The expedition will start about March 2, and will return early in the summer of 1899.

Any suggestions as to lines of investigation or methods of study will be gladly welcomed. If the curator of any museum or collection desires information respecting ethnographical objects from Torres Straits or British New Guinea, and sends sketches or photographs of such objects to me (Inisfail, Hills Road, Cambridge; or Thursday Island, Torres Straits, Queensland), I will take the illustrations with me, and will endeavour to obtain the required information at the spot where the objects were obtained. I shall also be pleased to make, as far as I am able, any special inquiries that any ethnologist may require.

ALFRED C. HADDON.

MINE ACCIDENTS IN 1897.

WITH commendable celerity the Home Office has issued, in the form of an advance proof, the tables of accidents and deaths at the Mines and Quarries of the United Kingdom last year. Six foolscap pages closely printed with figures are not likely to attract the ordinary reader; but if they are carefully scanned, several important facts come to light. The Diamond Jubilee year is remarkable for its small death-roll from explosions of fire-damp, as there were but twelve fatal accidents and only nineteen deaths. Probably such a happy result has not been known this century; at all events since 1851, when official statistics first began to be kept, the number of explosions has been gradually diminishing in the most satisfactory manner, and though several great disasters, each involving a loss of more than a hundred lives, have happened of late years, the total number of deaths from explosions has decreased, in spite of the enormous rise in the output of coal. According to the official statistics, the annual number of victims by explosions of fire-damp and coal-dust for the last forty-seven years has only in seven cases been fewer than 100, and in no case less than 49 until last year. Far less satisfactory is the death-roll from falls of ground; this shows no signs of diminution; on the contrary, we find 485 deaths against 439 in the previous year. How long is this state of things to continue? Why do falls happen? The reply is "From want of supports," and the self-evident remedy which suggests itself is "systematic timbering." The German Government has taken the matter in hand by appointing a special Commission to report upon means of preventing accidents from falls of ground. Are we to wait until this Report is issued before grappling with the question? The dangers of fire-damp and coal-dust have now been dealt with by Statutes; and the worst death-trap in the mine should also receive in its turn some special legislative attention?

Shaft accidents are diminishing in number in a way that makes the shaft nowadays almost the safest place in the mine. The miscellaneous accidents, most of which are put down to haulage, are still numerous. It is curious to note, while dealing with fatalities from miscellaneous causes, that the worst mining disaster in the British Isles last year happened at a lead mine and not at a colliery, for an underground fire claimed twenty victims. On the whole, there were 972 persons killed by accidents at mines in this country last year, compared with 1065 in 1896. This is a decrease of ninety-three deaths. How far this is a real improvement cannot be stated until the statistics of persons employed have been collected, so as to enable the death-rate to be calculated.

The final tables tell us that 123 persons were killed at the quarries of the United Kingdom which are included by the Quarries Act, from being more than 20 feet deep. There is a decrease of one death compared with 1896.

The statistical matter has been set up this year in an improved and far more convenient fashion, for the figures can now be read without twisting round the pages sideways.

THE PROPOSED MIDLAND UNIVERSITY.

EDUCATIONAL authorities throughout the country cannot but rejoice in the important speech which Mr. Chamberlain made in Birmingham on Thursday last. A recent Act of Parliament has been passed whereby the Mason College has been made a University College, governed by a representative court of governors, and it was in his new capacity of President of the Mason University College that Mr. Chamberlain took the opportunity of formally launching the scheme for the creation of a great University of the Midlands. The idea of a Midland University has been under consideration for several years past, and with the strong support now promised by Mr. Chamberlain, Birmingham may confidently look forward to shortly becoming the proud possessor of what London has been struggling in vain so many years to obtain—a great teaching University depending for its position and authority not on traditions, but founded in harmony with modern requirements, in sympathy with the scientific and educational needs and aspirations of the day.

Prof. Mahaffy, a few weeks ago, humorously represented some of the objections which have been raised to the establishment of a new University in Birmingham by remarking, "Oxford I know, Cambridge I know; but who are ye?" Mr. Chamberlain, however, has met and anticipated such and similar flimsy protests by at once, in his characteristic manner, going to the root of the matter. "The new University cannot in any sense be a competitor with the old Universities of Oxford and Cambridge . . . they offered associations, traditions, and conditions which it could not, under any circumstances, attempt or hope to emulate. Therefore, whilst they could not imitate Oxford and Cambridge if they would, he would say also that they *would not if they could* . . . because when they came to create new Universities in this modern time, and under modern conditions, it was something rather different they had in view." It cannot be sufficiently recognised that whilst traditions may be, and often are, a power for good, a slavish and blind adherence to them may also work incalculable mischief in society. It is not too much to say that the great University Colleges which have grown up in all parts of the country during the latter half of the present century, have been not a little hampered in their work, not a little shorn of the recognition due to them by being, in some respects, overshadowed by the older Universities. The splendid scientific work, however, which has emanated from these too frequently derided and belittled Provincial Colleges is gradually bringing about a change in public opinion. The munificent support which has recently been accorded to the Owens College, Manchester, and the attitude which so distinguished a statesman as Mr. Chamberlain has taken up with regard to the proposed Midland University, are auguries that a new era is commencing, when the public are beginning to realise what has been and still remains to be done by modern Universities unhampered by local traditions, in touch with the time, and animated with enthusiasm not only for the communication of knowledge, but for the advancement of learning by the prosecution of original researches. There is one point to which we venture to hope those entrusted with the great task of building up this new University will give due weight, and that is the study of modern languages. We as a nation are far behind Germany, for example, in the importance which we attach to the acquirement of foreign tongues, and our trade, we have often been told, suffers in consequence. Let Birmingham set the example, and in addition to thoroughly equipping its faculties of science, art and medicine, let it have the honour of establishing a great school of modern languages. Educationists in this country, who for years have been vainly endeavouring to obtain an effectual hearing for the need of harmonising modern scientific education not only with the requirements of the time, but with the advance in science, owe Mr. Chamberlain a debt of gratitude for his address, of which we give the following abstract from the *Times* report:—

The new governing body of the College were entertained at luncheon in the Council-house by the Lord Mayor (Mr. C. G. Beale), who proposed the toast of "Mason University College," which was coupled with the name of the president, Mr. Chamberlain.

Mr. Chamberlain, in reply, said that day's proceedings marked a stage in the history of the College. He did not dwell upon the service rendered by the College to the city and district, its rapid growth, and the reputation it had acquired, which was due in large part to the capacity and the character of the teachers it had been able to attract. The Mason College at the present time was hampered by a lack of resources. They had not the funds to deal with the growing requirements of the time and of the district, to provide proper appliances, proper buildings, and proper remuneration for those who acted as professors and demonstrators in the institution. The Lord Mayor had been good enough to say that the deficit was a moderate one, but deficits had a most uncomfortable habit of increasing, and, although the endowment which was provided for the College by the munificence of Sir Josiah Mason was sufficient for it in its infancy, it was inadequate for present requirements. The trustees had always contemplated the possibility that they would be able to crown the edifice of their educational institution by the establishment of a local University to meet the requirements of the district, and he need hardly point out that if that object found favour in their eyes, as the greater included the less, so the relief desired would come in the creation of a properly-endowed University into which the Mason College would be practically absorbed. He hoped the ambition to which he had referred would not in the present day be considered unreasonable.

THE MULTIPLICATION OF UNIVERSITIES.

There was a time, no doubt, when members of the older Universities, and men who were altogether independent of them, believed that the multiplication of Universities would injure education; that it would lead, in a certain sense, to the degradation and the lowering of the value of the degrees which Universities conferred; but very much had happened in the last twenty years, and he could hardly imagine any reasonable man arguing in that strain at the present moment. The fact was the need of the local University had been recognised, and at the present time Birmingham, and the surrounding district, was the only great centre in England which was not already provided with such an educational institution. Liverpool, Manchester, and Leeds had their Victoria University; Newcastle was closely connected with Durham; Wales had its own University; London had a University of a kind, which, when Londoners were able to make up their minds, would no doubt develop into something much better. He could not conceive of any district at the present time which more needed or more deserved the establishment of such an institution than the district in which he was speaking. But if they went outside England the argument was greatly strengthened. They looked to Germany for an example and a model of everything in the way of educational organisation and progress. Education was made in Germany, and they were not ashamed to take the lesson to heart. Germany, with forty-six millions of people, had twenty-one Universities. Their own sister kingdom, Scotland, with four million people, had four Universities; in England and Wales, with nearly thirty millions of people, they had six Universities. *A priori*, at any rate, he thought they had made out a case for a University.

EDUCATION IN THE MIDLANDS.

But there were other reasons he drew from the educational history of the district. The right hon. gentleman then proceeded to sketch the rapid and remarkable development of education in the district, speaking in high terms of the educational institutions. They had Mason College, which at last had been incorporated as a full University college. Was it not clear that after that which had been accomplished so rapidly they might ask without presumption for an institution which should crown that circle of their educational opportunities, and which should direct and control and guide and coordinate these local educational works, and so put themselves in a position to equal and rival every other part of the kingdom? He would like to strengthen his argument by a quotation from a man who, perhaps more than any other, was qualified to speak upon that subject—he meant the late Prof. Huxley, who said: "But a city University is, in my judgment, a corporation which has charge of the interests of knowledge as such, and the business of which is to represent knowledge by the acquirement by its members of increased knowledge, by their investigations to diffuse knowledge, by their teaching, and last, but not least, to create a respect for knowledge among their fellow men by their personal example and influence." Prof. Huxley was writing then in reference to the proposed creation of a University for Manchester. Whatever argument was then applicable to Manchester was applicable in no less a degree to Birmingham and the district, because he believed that there was no district in the kingdom that was so distinct in what he might call the peculiar genus, knowledge, and character of its people, and in the nature of its occupations as that great manufacturing district which had the vast population of more than 2,000,000 or so in and around Birmingham within a radius of twenty or thirty miles.

THE OBJECTS OF THE UNIVERSITY.

What did they mean by a University? What new institution was it they desired to place in Birmingham? They meant, he took it, a great school of universal instruction not confined to any particular branch of knowledge, but taking all knowledge as its province, and arranging regular courses of complete instruction in all the great branches of information. They must, in the second place, use that knowledge so that the professors and teachers should be associated with the students, and all should be students together, and so that those who came to teach should continue to learn, and so that the most important work of original research should be continuously carried on under the most favourable circumstances; and, lastly, they meant by a University a body which should have power to control the courses of education and to confer degrees which should test the value of its instruction. He put that last because he believed that of the three objects of the University it was the least important, although it was necessary to a University, and without it Mason College had lost a number of students. One thing he might at once admit. Any new University which they might succeed in establishing would not be in any sense a competitor with the old Universities of Oxford and Cambridge. Those Universities appealed necessarily to classes many of whom they could not expect to touch, and they offered associations, traditions, and conditions which they could not under any circumstances attempt or hope to emulate. Therefore, while they could not imitate Oxford and Cambridge if they would, he would say also that they would not if they could, because, while the older Universities supplied a want of their own, and if anything were to happen to them they would leave an incalculable gap in all that was interesting and picturesque in English life and English history, yet when they came to create new Universities in this modern time and under modern conditions it was something rather different that they had in view. He would say, rather, that they should take as their model, not indeed absolutely, the great Universities of Scotland—of Edinburgh or of Glasgow. He thought the University of Glasgow was built, much as they hoped theirs would be, upon a pre-existent college which had subsequently been absorbed or developed into a University. But there was no doubt whatever, from the experience of such Universities as those he had referred to, that to place them in the middle of a great industrial and manufacturing population was to do something to elevate the whole mass to higher aims and higher intellectual ambitions than would otherwise be possible to people engaged entirely in trading and commercial pursuits.

THE NEED OF MONEY.

Rome was not built in a day, and their University would, he dare say, for generations yet to come give opportunities to liberal benefactors to improve and extend it. But one thing was essential, one thing they must do—put the University in a position to attract the best teachers, to attract men of the highest reputation, and to keep them there when they had induced them to come. Pointing out how this ideal could be attained, Mr. Chamberlain remarked that all they wanted was very little—only money; and that, he hoped, would be forthcoming. The sacrifice must be proportioned to the importance of the object they had in view. He had no idea that Birmingham or the district would be satisfied with a starved University. He would rather wait another fifty years if necessary than start with everything pinched and mean about them, with insufficient buildings, with inadequate appliances, and, above all, with insufficient remuneration for those whom they employed. Therefore, he urged that they should start the scheme with a determination to make it a great success. Let them start it with an endowment which, at all events, would secure the main objects which they had in view. It was calculated that what would be required would be 250,000*l*. He was not at all inclined to minimise a demand of that sort made under the circumstances. Money would not be spent in colossal buildings. They must come later on. It was chiefly to secure a satisfactory endowment for a complete professorial body in connection with the University. In addition to the chairs which were already endowed they wanted endowments varying from 400*l.* to 600*l.* a year, which he did not think would be considered by any one as excessive, for fifteen chairs. The cost of such an endowment was, therefore, from 12,000*l.* to 20,000*l.* If this work was to be carried on they must not expect too much from individuals. They might expect something from the great trade of Birmingham, a little from each member of the trade, if they would organise themselves for the purpose. The great industries when appealed to would see that they had a great duty in that matter, and would be glad to be represented in the work. They had already made some progress, and from two or three whom they had approached they might certainly expect the endowment of such a professorship. His duty that day was to put the question before them and ask them to accept the principle and give their good will and assistance in carrying it out.

FRANCESCO BRIOSCHI

BIOGRAPHICAL notices of this veteran Italian mathematician, who died on December 13 last, have been given in the *Comptes rendus* by M. Hermite, and by Cremona and Beltrami in the *Annali di Matematica*, the journal of which Brioschi was chief editor, and one of the founders in 1858; from these notices many of the following details of Brioschi's scientific work have been extracted.

This work covers about half a century in time of production, and ranges over the subjects of Analysis, Geometry, Higher Algebra, Differential Equations, Elliptic and Abelian Functions, Mechanics and Mathematical Physics.

Brioschi occupied himself at first with various dynamical questions, in continuation of the researches of Lagrange and Dirichlet. He next turned to the development of Gauss's analytic theory of surfaces, which had hitherto not attracted the attention it deserved. He also discussed the theory of the Correspondence of Poncelet's Polygons; as subsequently developed by Moutard and Halphen, this theory appears likely to provide the simplest analytical view of the Multiplication and Division of Elliptic Functions, at present engaging the attention of Prof. H. Weber.

But the true bent of Brioschi's genius was found when he attacked the general theory of algebraical equations, being inspired by Hermite's discovery of the transcendental solution of the quintic equation, which has recently been summarised with developments in Klein's Lectures on the "Ikosahedron."

The history of the quintic equation throws a curious light upon the ways of a certain typical British school of mathematicians, who are accustomed to jog along in intellectual isolation, knowing and caring nothing for the advances made by others; like "Rip van Winkles," as Clifford called them.

Working in this hermit-like way, Mr. Jerrard made the important discovery that it was possible by the solution of algebraical equations of an order not higher than the third, to reduce the general quintic equation to the trinomial form; but Klein has pointed out, in the "Ikosahedron," that all this had been done a hundred years ago, by the Swedish mathematician Bring, in 1786.

Arguing by analogy, Mr. Jerrard, it is related, was firmly convinced that by the solution of a quartic, it would be possible to reduce the quintic to the binomial form, when the algebraical solution would be complete; and he died in happiness before having discovered his error, which a slight acquaintance with the work of Abel and Galois would have revealed.

The reduction by Hermite of the general quintic equation to the form of the Modular Equation of the Transformation of the Fifth Order of Elliptic Functions suggested to Brioschi the examination of the corresponding equations of higher order; and Brioschi's last communication was one to the Mathematical Congress at Zürich, 1897, on the particular case of the Transformation of the Eleventh Order.

Galois's statements ("Les idées précipitamment émises," Halphen, "Fonctions elliptiques," iii. p. 124), which he did not live to demonstrate, that the Modular Equations of the Fifth, Seventh, and Eleventh Order have Resolvents of the same order, had long baffled analysts, and they did not receive universal acceptance till the appearance of the article in "Tortolini," 1853, by Betti, Brioschi's co-editor, who succeeded in retracing Galois's line of argument; Betti's article being followed up by Hermite, in the *Comptes rendus*, 1859.

In his biographical memoir M. Hermite points out that Brioschi was the pioneer in another line of generalisation in the theory of algebraical equations, in his discovery of the solution of the general sextic equation, employing for that purpose the six even Θ functions, of two variables. The details of the development of this theory will afford plenty of employment to young mathematicians for some time to come.

In addition to his scientific labours, Brioschi found time to devote to public duties; he acted as an Under-Secretary of State, and was a Senator of the Upper House of the Italian Parliament; he was an organiser of the railway system of Italy, and he served on the International Committee of the Metric System.

He was a member of most of the Academies and Scientific Societies of Europe and America, and President of the Royal Academy of Lincei. The biographical notices by those who were personally acquainted with him speak highly of the respect and esteem which he inspired. G.

REV. C. L. DODGSON.

A FORMIDABLE champion of Euclidean methods in the elementary teaching of geometry has just passed away after a short illness. The Rev. Charles Lutwidge Dodgson was born in 1832 at Daresbury in Cheshire; and, after passing five years at Rugby School, matriculated in 1850 at Christ Church, Oxford, where he was appointed a student in 1852, and graduated in 1854 with honours in both classics and mathematics. He was appointed Mathematical Lecturer in the College in 1855, and retained that office till 1881; he further served the University as Mathematical Examiner in 1863, and Moderator in 1868.

The mathematical subject in which he was most interested was the elementary teaching of geometry; of this he had a personal experience of twenty-six years. Without stint of labour he submitted to rigid logical analysis every text-book on the subject that came to his notice, undismayed by their surprising number, the result being the amusing and, at the same time, deep "Euclid and his Modern Rivals," published in 1879, in which he demonstrated the logical superiority of Euclid's method over all the others examined. The Appendices of this book are very valuable. A "Supplement" to it appeared in 1885. In 1882 he edited Euclid, Books I. and II., with an introduction; and in 1888 he published "A New Theory of Parallels," in the third edition of which (1890) he simplified his fundamental axiom.

His other mathematical work comprises "A Syllabus of Plane Analytical Geometry" (1860), "Formulæ of Plain Trigonometry" (1861), "An Elementary Treatise on Determinants" (1867), "Euclid, Book V., proved Algebraically" (1874), and "Pillow Problems" (1893). He invented a new method of evaluating determinants, which is published in the *Proceedings* of the Royal Society for 1866, and also a method (which was published in NATURE) of easily determining the day of the week corresponding to any date. In October last he described in NATURE a brief method of dividing a given number by 9 or 11; and a second paper on the same subject, which appears in our correspondence columns this week, probably represents his latest contribution to mathematics.

A characteristic of all his work was the absolute exactness of expression at which he aimed, so that his definitions and proofs should be logically perfect. This carried a certain severity into his work, since, as he has himself remarked, a semi-colloquial style is apt to be also semi-logical, as nothing is more easy than to forget, in an argument which is interwoven with illustrative matter, what has, and what has not, been proved. It further tended to require the repetition of what might for exactness have to be a somewhat cumbrous periphrasis, to prevent which, therefore, he introduced a number of new terms and symbols; few of these have, however, been adopted into general use, though of the latter some are extremely expressive, and in his hands were of great value.

Mr. Dodgson's mind was essentially logical, in spite of the whimsical humour which has endeared "Lewis Carroll" to every boy and girl—nay, every adult—in the kingdom; and of late years he devoted a large part of his time to the study of the syllogistic methods of formal logic. In 1887 he published "The Game of Logic," and in 1896 "Symbolic Logic, Part I."

A shy and retiring man, he was to his friends a most charming companion, overflowing with the quaintest of humour, and one whose love for children was typical of himself, and whom to know was to love.

NOTES.

MATHEMATICIANS of all countries will be glad to hear that active steps are being taken to perpetuate the memory of the late Prof. J. J. Sylvester in a manner worthy of his reputation and in consonance with the spirit of his work. The movement was originated in this country by a few friends and admirers of the late Professor's, who decided upon founding a Sylvester Medal for the encouragement of mathematical research. The sympathy with the movement displayed by all the mathematicians who were communicated with, led the initiators to the conclusion that the most appropriate memorial would be one of international foundation, the more especially as Sylvester had a large number of friends and pupils in America, where indeed he may be said to have brought about a mathematical awakening through his connection with the Johns Hopkins University. The list of the International Committee which has now been issued, although only a preliminary one, comprises nearly the whole of the leading mathematicians of the world, besides many of the personal friends of the deceased mathematician and the representatives of the Universities of Oxford, Cambridge, London, Glasgow, Edinburgh and Dublin. From this list it might appear invidious to select names, but it is satisfactory to be able to call attention to the fact that it includes the Chancellor, High Steward and Counsel of the University of Cambridge, the Vice-Chancellor of the University of Oxford, the Provost of Trinity College, Dublin, the President of University College, London; with Lord Kelvin and Prof. P. G. Tait as representatives of the Universities of Glasgow and Edinburgh, and Prof. Henrici of the City and Guilds Institute. France is represented by Profs. Hermite, Poincaré, Camille Jordan, and Darboux; Germany by Profs. Schwarz, Klein, Fuchs, Gordan, and Lindemann; Italy by the late Prof. Brioschi, and by Prof. Cremona; and Sweden by Prof. Mittag-Leffler. America has no less than fifteen names on the list, among them being President Gilman of the Johns Hopkins, Profs. Simon Newcomb, Willard Gibbs, and others representing the mathematical chairs of the various Universities. It is indeed certain that some movement of the kind would have been initiated in America if Sylvester's admirers in this country had not taken action. Now through Dr. Cyrus Adler, of the Smithsonian Institution, and Dr. G. Bruce Halsted, of Texas (a former pupil of Sylvester's), the Americans are working for the general scheme, and the two gentlemen named are acting as Treasurers for the United States. The general Treasurer of the fund is Lord Rothschild; Major P. A. MacMahon is acting as Hon Secretary, and Prof. Meldola, as a friend of the late Prof. Sylvester's, undertook the arduous work of preliminary organisation with the results which we are now making public. The executive Committee consists of Lord Rothschild, Major MacMahon, Prof. Forsyth, Prof. Greenhill, Prof. Henrici, and Prof. Meldola as Organising Secretary. We are informed that the subscriptions from private sources reached over 500*l*. at the end of the year, and now exceed 600*l*., the American contributions not having yet been forwarded. It is proposed that the Medal shall be awarded triennially through the Council of the Royal Society, irrespective of nationality. Any friends of Sylvester's, or others who desire to participate in the movement, may send contributions to Lord Rothschild, New Court, St. Swithin's Lane, E.C.

MRS. TYNDALL, the widow of Prof. Tyndall, has sent the following letter to Sir James Crichton-Browne, F.R.S., the Treasurer of the Royal Institution: "Dear Sir James,—As an expression of his attachment to the Institution, with which he was so long connected, and of his sympathy with its objects, my dear husband desired me (at such time as should be most convenient to myself) to present in his name to the Royal Institution 1000*l*. to be disposed of as the Board of Managers may see fit for the promotion of science. I have now the pleasure of remitting to you this sum. Yours faithfully, LOUISA C. TYNDALL." Sir James Crichton-Browne, in the course of his letter acknowledging this generous donation, remarks:—"The managers would, I am sure, desire to be guided by any wish of yours as to the application of the gift; but, in the absence of any explicit directions, they will, I have no doubt, employ it in the promotion of that original scientific research in which your husband's vivid and penetrating intellect delighted to exercise itself. Revered as your late husband's memory is, and ever must be, in the Royal Institution, this posthumous mark of his solicitude for its welfare will, if possible, deepen the affectionate esteem in which he is held."

THE Council of the Royal Astronomical Society have awarded the Gold Medal of the Society for this year to Mr. W. F. Denning, "for his meteoric observations, his cometary discoveries, and other astronomical work." The award was confirmed on Friday last, and the medal will be given at the annual general meeting next month.

THE deaths are announced of Dr. Eduard Lindemann, scientific secretary in the observatory of Pulkova; and Dr. Oscar Stumpe, well known for his contributions on the motion of the solar system.

DR. MAQUENNE, assistant at the Paris Muséum d'histoire naturelle, has been nominated professor of plant physiology, in succession to the late M. Georges Ville.

AT the February meeting of the Edinburgh Mathematical Society, a discussion on the proposal that, in the teaching of elementary geometry, Euclid's definition of proportion be abandoned, will be introduced by Prof. Gibson.

WE regret to see the announcement of the death of Lieut.-Colonel C. Cooper-King, lecturer in natural science at the Staff College, Camberley. Colonel Cooper-King was a Royal Marine Artillery officer, and before joining the Staff College was an instructor at the Royal Military College, Sandhurst.

A LETTER which appears in our correspondence columns, on poisoning from Koda millet, which is extensively used as a food-grain in times of scarcity, furnishes another instance of the urgent need that exists for further facilities for scientific investigation in India. Matters are continually arising which ought to be made the subjects of systematic inquiry, but at present the means for carrying out such investigations are altogether inadequate to the wants of our great Indian Empire.

WE learn from *Science* that ground was formally broken for the Museum Building of the New York Botanical Garden on December 31. The construction and equipment of the building will cost 347,019 dollars. The plans for the great range of horticultural houses have been completed, and specifications for them have been printed. The sum of 15,000 dollars, in addition to the funds provided by the Act of Incorporation, has been made available for the building of portions of the drive-way system. During the past season about 2900 species of plants have been obtained, together with large quantities of museum, library, and herbarium material.

THE Royal Photographic Society is organising an international exhibition of photographic apparatus and photographs, which will open at the Crystal Palace on April 27. In addition to the usual displays of pictures, &c., the leading firms, manufacturers and dealers, will be largely represented. There will also be extensive loan collections, illustrating not only the history of photography, but its scientific and commercial applications, photo-mechanical processes, photographs in colours, photographs by means of the X-rays, and kindred exhibits. The exhibition, the arrangements for which are in the hands of a joint committee of members of the Society and exhibitors, promises to be the largest and most interesting collection dealing with photography that has ever been got together.

THE sixteenth annual meeting of the American Society of Naturalists and Affiliated Societies was held at Cornell University at the end of last year. In the absence of the president, Prof. Whitman, of the University of Chicago, the chair was taken at the opening meeting by Prof. S. F. Clarke. The officers elected for the ensuing year are :—President : H. P. Bowditch, Harvard Medical School. Vice-Presidents : Prof. Wm. James, Harvard University ; Prof. Simeon H. Gage, Cornell University ; Prof. H. S. Williams, Yale University. Secretary : Prof. H. C. Bumpus, Brown University. Treasurer : Prof. John B. Smith, Rutgers College. Executive Committee : Prof. J. P. McMurrich, University of Michigan ; Prof. E. G. Conklin, University of Pennsylvania. At the instance of Prof. Morgan, of Bryn Mawr College, the Society voted one hundred dollars towards an additional table at the Naples Marine Biological Station, and fifty dollars for the Naturalists' Table at Woods Holl. It was reported that President McKinley was about to appoint a politician to the office of Fish Commissioner, and the sentiment of the assembled investigators upon this matter is shown in the following resolution presented by Prof. C. L. Bristol, of New York University, and supported by Prof. H. F. Osborn. "Resolved : (*a*) That the American Society of Naturalists as representatives of the principal scientific and educational interests of this country, unanimously express to the President and Congress of the United States their sentiments that the Commissioner of Fish and Fisheries should, according to the law of 1888, governing his appointment, be a person of proved scientific and practical acquaintance with the fish and fisheries of the coast. (*b*) That it is of the utmost importance that the Fish Commission, as one of the most useful scientific institutions of the Government, should be free from political influence and should be administered with the highest degree of scientific efficiency by an experienced officer." A discussion was held on the subject of "The Biological Problems of To-day," and it was dealt with from the points of view of palæontology, botany, anatomy, psychology, physiology, developmental mechanics, and morphogenesis. In addition to the combined meetings of the societies, the following bodies held separate meetings for the communication and discussion of papers bearing upon their particular branches of science : American Physiological Society, American Morphological Society, American Psychological Association, Association of American Anatomists, Association for Botanical Morphology and Physiology, Section of Anthropology of the American Association. The Society will meet next winter at New York.

IN the *Zeitschrift für Vermessungswesen*, Prof. Hammer directs attention to a Babylonian plan depicted on a clay tablet found in the excavations at Tello, and now preserved in the Constantinople Museum. The plan was made about 3000 years before the Christian era, and represents an estate belonging to King Dungi. It is of importance not only as a contribution to the early history of surveying, but also as a confirmation of the views on Babylonian measures of length and of area propounded by Reisner at a meeting of the Berlin Academy of Sciences on April 9, 1896. A copy of the plan has been examined by Eisenlohr, the eminent authority on Egyptian archæology, and he claims to be able to read from the cuneiform inscription the names of the two surveyors engaged. On one side of the tablet there is a dimensioned sketch of the plan of the estate not drawn to scale. The estate is divided by the survey lines into rectangles, right-angled triangles, and trapeziums. In each case the area is stated, two results obtained by different methods being given. Eisenlohr has plotted the survey, and his calculations of the area agree with the results given on the tablet. On the other side of the tablet the areas of the various portions are added together, two sets of figures being used, and the arithmetical mean taken as the correct area. The unit adopted, the *gan*, is thought to be equal to 4199 square metres. The absolute measures are, however, of slight importance. More important is the fact that land surveying was carried on 4000 years B.C., apparently in an accurate manner, and certainly with check measurements.

M. E. DUBOIS (*Bulletins de la Société d'Anthropologie de Paris*, 1897, fascicule 4) infers from theoretical grounds, based partially upon observation of the proportion of the surface of the retina to that of the body, that the weight of the brain of mammalia of similar form and the same species, varies directly as the surface of the animal.

A FRESH development of Dr. Folgheraiter's investigations on the magnetic properties of Etruscan vases is described in the *Rendiconti della R. Accademia dei Lincei*, vi. 12, the object of the present experiments being to discover by what process the black vases obtained their colour. Three hypotheses had been advanced by archæologists : the first, that the vases were made of a special kind of clay ; the second, that the clay was mixed with fine carbon or lamp-black ; and the third, that the colouring matter was introduced into the clay after the vases had been formed, and possibly after they had been baked. Dr. Folgheraiter found, however, that carbon mixed with clay disappeared almost completely when heated to a temperature of about 380°, and that fragments of the old vases also lost their colour at that temperature ; while to account for the magnetic properties of the vases they must have been heated to over 420°. Moreover, the clays experimented on did not lose their plasticity until a temperature of 420° to 500° was reached. The first two hypotheses were thus negatived. With regard to the third, it was found that the blackening could not be effected by heating in a closed chamber full of carbon ; moreover, if the carbon was infiltrated into the pores of the clay by carbonisation, it did not burn away till a higher temperature was obtained than was sufficient to decolorise the vases. Thus neither of the three hypotheses was corroborated by experiment. Dr. Folgheraiter suggests as a possible explanation that the clay, after being baked, may have been soaked with bitumen, and then heated to 300° ; it would thus acquire a polished black surface with the colour gradually fading towards the interior, as in these Etruscan vases.

THE "Illustrations of Maori Art," by Mr. H. Hamilton, now in course of publication by the New Zealand Institute, is the most attractive contribution to ethnography we have seen for a long time. The first part of the work, on the Canoes, was issued some months ago, and the second part, dealing with material relating to "Maori Habitations," has lately come to hand. The three succeeding parts will be devoted to weapons, dress and decoration, and social life. The present part contains twenty-three plates upon which are reproduced, by half-tone process, photographs of characteristic buildings of the New Zealanders, and ornamentations with which the framework and different parts of the habitations were embellished. The accompanying illustration, which reproduces one of the plates on a reduced scale, is a testimony to the ability of the Maoris as wood-carvers, and to the high quality of the pictorial part of Mr. Hamilton's work. The carvings here shown are ornaments for doorways, the three upper ones being in the South Auckland Museum, and the lower one in Mr. Hamilton's own collection. In addition to illustrations of this kind there are twenty-nine examples, in chromo-lithography, of Maori rafter patterns; diagrams of the construction of a Maori house; a valuable introduction on the habitations of the Maoris; and descriptive notes on the illustrations. The work is commendable both in plan and execution, and when it is completed we shall refer more fully to its scope and value.

Maori Carvings for Doorways.

A PHOTOGRAPHIC method of measuring the height of a balloon, and at the same time comparing the results with those furnished by barometric readings, is described in *La Nature* for January, by M. L. Cailletet. The apparatus consists of a camera with one lens pointing downwards, by means of which a photograph of the country below the balloon is taken ; at the same time a lens at the top of the camera projects on the upper side of the sensitised film an image of the dial of an aneroid barometer placed above the apparatus. By measuring the distance between any two points on the photographic view, and comparing with a map of the district, the altitude of the balloon can be accurately found, and the law connecting it with the barometer reading verified experimentally.

THE Pilot Chart of the North Atlantic Ocean, issued for the present month by the Hydrographer of the United States, shows that some very severe weather was experienced during December. Many of the storm centres were in high latitudes, so that vessels along the Transatlantic routes met with north-westerly squalls of hurricane force, accompanied with snow and hail. The most severe storm of the month was one situated about latitude 54° N., longitude 44° W., on December 6, and which reached the neighbourhood of the Orkney Isles on the 8th and 9th. For some days the wind blew with hurricane force north of latitude 55° N., and east of longitude 20° W. It often happens, especially in the winter season, that in the vicinity of the Azores rough weather is experienced or several days at a time ; and, with the view of illustrating the behaviour of these storms, a synoptic chart of one of them is given. They differ from the storms of other regions in that the barometric depression rarely attains any great depth, and that they follow an irregular course, the centre frequently recurving in a manner suggesting an effort to get to the eastward in the face of some resisting force, probably an area of high barometric pressure in the vicinity of the British Islands. Another feature of these storms is the suppression of the trade-winds, which is an important consideration for vessels bound from the Equator to the Channel.

DR. A. FRANZ contributes a long paper to the *Deutsche geographische Blätter*, on the possibility of establishing regular communication by sea between Europe and Western Siberia. The meteorological and hydrographical conditions are examined with as much detail as the somewhat scanty observations available admit ; and the general result seems to show that the difficulties in the way of regular navigation are not insuperable, although sufficiently great to make it doubtful if it is worth while, from a commercial point of view, to try to overcome them.

THE first part of a new volume of the *Memorie della Società Geografica Italiana*, recently issued, contains, besides other shorter papers, the results of an exhaustive research into the records of earthquakes in Italy during the period 1800 to 1872, by Signor M. Baratta. The author does not pretend to completeness, but his list is, as he says, a great advance on anything hitherto available. The arrangement is chronological, and under each date are given the places where the disturbance was recorded, the hour, the nature, direction, and intensity of the shock when possible, and finally the source of information.

THE *Mittheilungen du k.k. Geographischen Gesellschaft* of Vienna contain a note announcing satisfactory progress in the work of organising a meteorological service in the parts of the Balkan peninsula under Austrian rule. Discussion of the observations already made throws considerable light on the obscure transitional phases of climate occurring between the Mediterranean and continental regions.

WE have received the third volume—that for 1894—of the *Bibliotheca Geographica*, edited by Dr. Otto Baschin. The work has been carried out with the same completeness and accuracy as formerly. The only new feature is an extension of the number of Slavonic languages included. The experiment of giving titles of papers in Russian and Czech, with German translations appended, was tried for the first time last year, and has been so far successful that Polish and Croatian literature is now added.

THE Director of the Botanic Gardens at Buitenzorg, Java, has issued in English a Hand-guide to the Gardens, in a neat square size, accompanied by a plan.

WE have received from the Gebrüder Borntraeger of Berlin a daintily produced catalogue of their natural history publications, especially in botany and geology. The firm has now been in existence over a century.

IN the *Transactions of the Academy of Science of St. Louis*, Prof. W. Trelease describes a remarkable instance of "phytobezoar," two balls from 3 to 4 inches in diameter, taken from the stomach of a bull, and composed entirely of the barbed hairs with which the cushions of species of *Platopuntia* are covered.

WE learn from the *Botanical Gazette* that the Secretary of Agriculture for the United States has included in his estimate of the expenditure for the coming year an item of 20,000 dols., to be set aside from the seed fund, for the introduction into the States of valuable economic plants. If sanctioned by Congress, Mr. D. G. Fairchild will be put in charge of the work. His extensive travels and his reputation as a botanist peculiarly fit him for the work.

THE *Botanical Gazette* states that the Biological Survey of the State of Alabama is being pushed and extended as rapidly as limited means will permit. Over 20,000 specimens have been added to the herbarium collection during the present year, including fine series of lichens, mosses, and liver-worts. Much of the success of the work is due to the activity and devotion of Prof. F. S. Earle and Mr. Carl F. Baker, of the Alabama Polytechnic Institute, and of other botanists of the Survey.

THE pitcher-plants of the genus *Nepenthes* are just now engaging the attention of systematic botanists. In the *Journal* of the Royal Horticultural Society for December 1897 is an elaborate article on their growth and culture by Mr. H. J. Veitch, with numerous excellent illustrations, to which are appended some remarks by Mr. F. W. Burbidge. Mr. F. M. Bailey describes the four Australian species in the *Queensland Agricultural Journal*, vol. i. part 5, giving figures of two of them.

THE first number of the new volume (vol. ix.) of the *Journal of Conchology* contains articles and notes of interest to conchologists. The size of the page has been enlarged, and an index is given of the volume just completed. Among the contents is the presidential address delivered by Prof. S. J. Hickson, F.R.S., on "Torsion in Mollusca." Mr. Lionel E. Adams records observations which distinctly show that the slug *Limax maximus* has a sense of smell.

THE eighth part of Mr. Oswin A. J. Lee's attractive work, "Among British Birds in their Nesting Haunts," has just been published by Mr. David Douglas, Edinburgh. The nests illustrated upon the ten fine plates are those of the song thrush, great crested grebe, great skua, tawny owl, bearded tit, common curlew, and siskin. This part appears to conclude the second volume of Mr. Lee's work.

A GOOD general view of physical and chemical science, designed mainly for medical students, is given in the "Physikalisch-chemische Propaedeutik" of Prof. Dr. H. Griesbach. (Leipzig: Engelmann.) The book is being published in parts, and the second part of the second half has just appeared. A knowledge of the principles of physics and chemistry is essential to the student of modern medicine, and Dr. Griesbach has set himself to show how physical methods bear upon medical science. Another part of the work remains to be published, and when it appears, we shall review the book in its completed form.

THE simplest member of the group of the ketoses, of which ordinary lævulose or fruit sugar is the best known representative, is dihydroxyacetone, $CH_2(OH).CO.CH_2(OH)$, which has long eluded the attempts of chemists to isolate it in the pure state, although mixtures in which it is undoubtedly present have been obtained by several investigators by the oxidation of glycerine. Oscar Piloty has now succeeded in preparing this interesting compound in the pure condition, and describes its properties in the current number of the *Berichte*. The starting point for its preparation is the oxime, $CH_2(OH).C:NOH.CH_2(OH)$, which can easily be obtained from the product of the action of formaldehyde on nitromethane, both substances of very simple constitution. When this oxime is treated with bromine, nitrous oxide is evolved and dihydroxyacetone produced. It crystallises well, and has a sweet and cooling taste. In other respects it also shows the well-known characteristics of the sugars, reducing Fehling's solution almost as powerfully as grape sugar, and yielding an osazone with phenylhydrazine. On reduction it is converted into glycerine, a new synthesis of this important compound being thus effected. The production of dihydroxyacetone from formaldehyde is of great interest in view of the important function which the latter is supposed by many to perform in the natural production of sugars in the vegetable organism.

THE additions to the Zoological Society's Gardens during the past week include a Macaque Monkey (*Macacus cynomolgus*) from India, presented by Mr. R. S. Gleave; two Aard Wolves (*Proteles cristatus*, young) from South Africa, presented by Captain Baker; a Greater Sulphur-crested Cockatoo (*Cacatua galerita*) from Australia, presented by Lady Pilkington; a Black-backed Piping Crow (*Gymnorhina tibicien*) from Australia, presented by Mr. T. G. F. Winser; two Herring Gulls (*Larus argentatus*), British, presented by the Rev. F. Hopkins; a Japanese Ape (*Macacus speciosus*) from Japan, two Ganga Cockatoos (*Callocephalon galeatum*) from Australia, a Red-tailed Buzzard (*Buteo borealis*) from Jamaica, deposited.

OUR ASTRONOMICAL COLUMN.

A NEW SPECTROSCOPIC BINARY.—In the Harvard College Observatory *Circular* (No. 21) Prof. E. C. Pickering announces that, from an examination of the Draper Memorial photographs, Mrs. Fleming has found that the star A. G. C. 20263, β Lupi, is a spectroscopic binary. The period has not yet been determined, but photographs are being taken for this purpose.

Measures of the spectroscopic binaries μ^1 Scorpii and A. G. C. 10534 show that the relative velocities of the components are approximately 290 and 380 miles respectively. The velocities are therefore much greater than in the case of ζ Ursæ Majoris and β Aurigæ. The separation of some of the lines amounts to as much as nine tenth-metres.

WINNECKE'S PERIODIC COMET.—A short time ago (NATURE, December 23, 1897) we gave Hillebrand's search ephemeris for this comet, and subsequently (January 6, 1898) announced its discovery by Perrine at the Lick Observatory, with a slightly different position from that calculated.

A supplementary note in the *Astronomical Journal* (No. 423) gives the corrections to be made to Hillebrand's ephemeris as

$$\Delta\alpha = +\ 2\text{m. }8\text{s.},\ \Delta\delta = -\ 9'.3.$$

Applying these values, we have the following approximately corrected ephemeris.

Berlin M.T.	α h.	m.	s.	δ °	′
1898, Jan. 18·5	16	22	8	− 7	51·4
„ 22·5	16	39	7	− 8	46·3
„ 26·5	16	54	44	− 9	39·6
„ 30·5	17	14	57	−10	30·6

LEVEL OF SUN-SPOTS.—Much has been said on both sides of the question as to whether sun-spots are concave or convex; and although the Wilsonian doctrine is generally accepted, there are at the same time many difficulties which tell against it.

At first sight it would seem that notches, seen and photographed when a spot is on the limb, go to support the theory; but on the contrary, as Father Sidgreaves pointed out (*Monthly Notices*, vol. lv. p. 285, 1895), they are difficult to account for by it. Again, a more serious objection than this is that both Langley and Frost have found that the ratio of umbral radiation to that of the neighbouring photosphere undoubtedly increases with the distance from the centre of the sun's disc; from this result it would seem that the umbral region whose radiation was measured was above the level of the photosphere, and consequently subjected to less absorption.

In the *Astrophysical Journal* (vol. vi. p. 366), Prof. George E. Hale considers the conclusions which seem to be at variance with the idea that spots are depressions, and suggests that spots may be hollows in comparatively small areas of the photosphere which are raised above the ordinary level; for most admit that the penumbra is at a higher level than the umbra, and it cannot be doubted that penumbral filaments overlie the umbra, and frequently unite to form bridges extending completely across it.

This theory, so far as he has examined it, seems to reconcile the conflicting testimony offered by the supporters of the two views. Notches at the sun's limb are accounted for by assuming that the side of the spot nearest us is somewhat lower than the opposite penumbra, and the darkening of the limb might thus be produced by the smaller radiations of the penumbra. Also, to account for the results obtained by Langley and Frost, it is only necessary to assume that the region of the umbra is slightly raised above the general level of the photosphere.

A VARIABLE BRIGHT HYDROGEN LINE.—From a comparison of the Draper Memorial photographs of the star A. G. C. 9181, taken on different dates, Miss A. J. Cannon has found that the bright hydrogen line $H\beta$ is variable (Harvard College Observatory *Circular*, No. 21). On October 5, 1892, it was invisible. On November 28, 1894, it was about half as bright as the corresponding line in A. G. C. 9198, ω Canis Majoris. On April 27 and 30, 1895, the line in A. G. C. 9181 was distinctly the brighter of the two, while in January 1897 it was again invisible. From a large number of photographs of this object taken recently it appears that this line, which was bright in October 1897, is now, December 27, invisible.

ASTRONOMICAL CONSTANTS.—It will be remembered that Dr. Fr. Porro, in a long letter to NATURE (December 9, 1897) on "Astronomical Constants and the Paris Conference," somewhat depreciated the adoption of some of the constants (especially that of precessional motion), believing "that a general renovation of fundamental astronomy must precede a new and authoritative definition of the numbers that the twentieth century must accept as the more probable values." In the *Astronomical Journal* (No. 423) Prof. Lewis Boss gives his rejoinder to Prof. Newcomb's remarks on his first paper, which criticised the adoption of the constant of precessional motion, and regrets that others have not replied before him. The additional note to Dr. Porro's letter referred to above, although very concise, formed to some extent a reply to Prof. Newcomb; but Prof. Boss's second paper goes into the matter in minuter detail. In conclusion, he thinks that the present time seems singularly inopportune for the adoption of a new evaluation of the precessional motion, and suggests that a new and ingoing investigation of the motion of the equinox should be made; for although the investigation made by Newcomb a quarter of a century ago was exhaustive for its time, new evidence has since accumulated which has not been brought to bear upon the problem; and we may confidently look for still more valuable observations from several observatories within the next ten years.

LONGITUDE OF MADRAS.—We have recently received the "Report on the Determination of the Longitude of Madras," by the officers of the Indian Survey. The difference of longitude actually determined on this survey was that between Greenwich and Karachi, the latter place being at the end of the submarine cable of the "Persian Gulf Telegraphs." It was only necessary to commence at Karachi, for the whole area of India has been covered with a network of longitude arcs, and by their means the difference of longitude between Madras and Karachi had been accurately determined beforehand.

The distance from Karachi to Greenwich, extending over 5197 miles of wire, was divided up into four main arcs, viz.:—Karachi—Bushire, Teheran—Bushire, Teheran—Potsdam, Potsdam—Greenwich, the clock comparisons being made by signalling over the telegraph wire connecting these places. The final result of these observations gives the longitude of Madras as 5^h 20m. 59s.·113, with a probable error of ±0s.·0227.

It now rests with the Government of India to decide whether this value should be adopted or not, for a change in the longitude of Madras affects not only British India, but the Malay Peninsula, Tonquin, China, the Dutch Indies, and Australia.

THE ELECTRO-CHEMICAL INDUSTRIES.[1]

TWO months hence there should be celebrated in Como the centenary of Volta's famous discovery, to which we owe the rise of electro-chemistry. Electrical phenomena had been studied long before Volta's time; but if we except the action of the electric spark employed by Cavendish to induce the combination of affinitive gases, no electro-chemical effects had been observed. The analytical power of the voltaic pile was first actually demonstrated by Davy, who made memorable the year 1806 by the electrolytic extraction of potassium from potash. To Faraday, who succeeded Davy, we owe the discovery of the law of electrolytic conduction and the enunciation of the principles of the dynamo. As early as 1842 magneto-electric current generators were employed in the Elkington factories at Birmingham, for electro-plating purposes; and comparatively within recent years the principle of electrotyping has been applied also to copper refining. It is estimated that one-third of all the refined copper required is now produced electrolytically. Metal produced in this way is purer and has a higher conductivity than that produced by the older method, which leaves an admixture of arsenic. The power required is relatively small, and the current density may vary within very considerable limits without detriment to the product and with the gain of great rapidity of deposition. The conditions required are to adapt the strength of the solution to the strength of the current, and when the current density is high to effect a rapid circulation of the electrolyte. Mr. Swan referred to a method devised by himself for producing pure copper wire directly by electrolytic action, so avoiding the slight loss of conductivity due to fusion and drawing. The process, however, was found to be too costly for commercial use.

[1] Abstract of the presidential address delivered by Mr. J. W. Swan F.R.S., before the Institution of Electrical Engineers, January 13.

The electrolytic extraction of metals from their ores is now employed on a large scale, in the case of gold, where it can be profitably applied to the treatment of tailings and waste sludges; of zinc, especially by the recent Hoepfner method of working from the chloride; of aluminium, and of sodium. Aluminium made its first appearance as a commercial product at the Paris Exhibition of 1855. Its price at the time was not far off that of silver. The cost is now equivalent to that of copper, whilst the production has mounted to 2000 tons per annum, and is rapidly increasing. Prof. Richards, well known as the author of the most complete treatise on aluminium, predicts that it is bound to rank next to iron in its production and usefulness to mankind. The principal methods of extraction at the present time are Hall's process, consisting of an electrolytic bath of potassium fluoride, in which alumina produced from bauxite is continuously dissolved; and Heroult's process, in which the solvent consists of cryolite, the double fluoride of aluminium and sodium.

The manufacture of alkali has already undergone many changes the past twenty-five years, one of which is the supersession of the Le Blanc process by the ammonia-soda process of Hemming and Solvay. The electrolytic treatment of brine for the production of soda and chlorine now threatens to displace all the older chemical processes, especially since the introduction of the successful rocking apparatus of Castner and Kellner, in which an end-to-end flow of mercury through three compartments prevents the mixing of the electrolyte, and effects the separation of the sodium and chlorine. A similar industry is the manufacture of chlorate of potash by electrolysis, in a tank divided by a porous partition, with very thin iridio-platinum anodes and iron kathodes. The electrolyte is usually a solution of chloride of potassium maintained at a temperature of 45° to 50° C. The action of this cell results in the formation at the anode of hypochlorite, which is immediately decomposed, with the formation of chloride and chlorate of potassium. In Switzerland and in Sweden this process is worked with great commercial success by the aid of power derived from water.

Amongst the class of electro-chemical processes depending on dissociation and combination at extremely high temperatures, Mr. Swan referred to the manufacture of phosphorus and of carborundum in the Acheson furnace. To the same category belongs the production of calcium carbide and a number of analogous products obtained by Moissan. Calcium carbide, for the production of acetylene gas, is now being manufactured at the rate of 20,000 tons per annum.

The production of ozone, with its secondary derivatives, vanillin and heliotropine, is dependent on another variety of electrical action, in which intermittent or alternating currents of high tension are employed. By the Andreoli and other practical processes, ozone is now being commercially produced and applied to numerous industries, such as the oxidation of oils, the seasoning of linoleum, and the pnrification of brewers' casks.

Such are a few of the principal uses to which Volta's discovery of the galvanic current is being applied. It remains to be seen how far the electrolytic and other electrical processes will supplant the older chemical processes as time goes on. We are probably at present only on the edge of the field that remains to be explored. Mr. Swan's advice to the numerous young electricians who are setting out in life, is that some of them should turn their eyes towards the rich possibilities that await them in this direction. We often hear that the profession of electrical engineering is already crowded. Here at least is a world that still remains to be conquered.

THE BRIGHTON MUNICIPAL SCHOOL OF SCIENCE AND TECHNOLOGY.

THE accompanying illustration shows the external features of the new School of Science and Technology opened at Brighton by the Duchess of Fife a few days ago. The building was designed by Mr. F. J. C. May, the Borough Engineer and Surveyor.

On the ground floor is a large vestibule with mosaic flooring, from which a wide marble staircase leads to the top of the building. A second staircase gives access to the three floors. On each of the floors there is a corridor extending from the front to the back of the building, for a depth of 162 feet, and from these corridors the workshops, class-rooms, lecture theatres, and laboratories open out on each side, with a master's private room for each department. In the basement are situated the boilers and engines for the electric lighting of the building, and for the supply of hot water and steam for the laboratories; here also is a smithy with forges, electrical workshop, carpentering, plumbing, and brickwork and masonry shops, and a dynamo room.

On the ground floor leading from the vestibule are rooms for the Principal, Secretary, Committee, and office; on either side of the corridor are an engineering drawing hall, an engineering workshop, engineering laboratory, metallurgical furnace room, typography shop, and various class-rooms. The workshop is fitted with a Tangye's gas engine, lathes, planing, slotting and drilling machines, &c.

The first floor is devoted mainly to chemistry and physics. The lecture theatres in both departments are fine halls, capable of seating 220 and 120 respectively. The chemical laboratory is fitted for forty-eight students working at one time, and is fully equipped. Besides class and preparation rooms for each department, the accommodation on this floor comprises, among others, rooms for photometry, and advanced physics, chemical research room, balance room, and photographic dark room. The second floor contains a lecture theatre and laboratory for the natural sciences, and lecture and class rooms for dressmaking and cookery.

The day school is a technical college, and provides extended courses in mechanical and electrical engineering, chemistry, natural sciences, and for the Arts and Science degrees of London University. The evening school provides courses in all science subjects, with practical trade classes in building, engineering, printing and chemical trades; languages, commercial subjects, and women's work. The staff of the school is composed as follows:—Principal, C. H. Draper, B.A., D.Sc.; chemistry, M. C. Clutterbuck, B.Sc., Ph.D.; natural science, H. Edmonds, B.Sc.; engineering, G. Armstrong, M.Sc. The total cost of buildings and equipment will be about 25,000*l*.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr. W. Ridgeway has been re-elected Disney Professor of Archæology.

Mr. Yule Oldham, University Lecturer in Geography, lectures this term on the Geography of Central Europe, and on Physical Geography, on Mondays and Thursdays respectively. He is also giving an extension course in the town on the Great Explorers, which is largely attended.

Sir Ernest Clarke, Gilbey Lecturer, gives his second series of lectures on Agricultural History and Economics on Thursdays during February, at noon, in St. John's College.

Mr. Osbert Salvin, F.R.S., and Mr. Ainger, Master of the Temple, have been elected to Honorary Fellowships at Trinity Hall.

MR. JOHN D. ROCKEFELLER has just given the Chicago University 200,000 dols., this being in addition to many previous gifts.

THE following are among recent appointments:—Dr. Julius Istvánffy to be professor of botany at Klausenburg; Dr. Alexander Mágócsy-Dietz to be assistant professor of botany at Budapest; and Prof. Dr. Zacharias to be director of the Botanic Garden at Hamburg.

THE Finance Committee of the Corporation have recently reported on the application of the Council of the City and Guilds of London Institute for a renewal of the grant from the Corporation to the funds of the institute. They state from inquiry that the work of the institute has been successfully and economically managed, and the results achieved are fully commensurate with the expenditure involved. The Corporation have, in consequence of this report, voted 400*l*. in respect of last year towards the funds of the institute, to be devoted to the Finsbury Technical College.

A COPY of the Calendar of the University College of Sheffield has been received. It will be remembered that the present College was constituted by Royal Charter last May, and was formed by the amalgamation of three pre-existing institutions—the Firth College, the Sheffield Technical School, and the Sheffield School of Medicine. These institutions had previously worked hand in hand, although under independent governing bodies. By the charter they were merged into one corporation with a single Court of Governors. The new Calendar shows that the College is doing valuable work by providing the people of Sheffield and the district with the means of higher scientific and literary education by University methods of teaching.

AT a meeting of Convocation of the University of London on Monday, the report of the special committee appointed to consider the Commission Bill was adopted. After a discussion the following resolution, recommended by the special committee and moved by Dr. J. B. Benson, was carried, an amendment to it being rejected by seventy-six votes to forty-two: "That this House accepts the scheme embodied in the London University Commission Bill, 1897." The special feature of the resolution adopted rests upon the fact that it was supported by one of the sections that had always hitherto opposed the Cowper scheme. The opponents belong to two classes: the no change—that is, the two Universities section, who are still irreconcileable, and the section which favoured procedure by charter, and not by statutory commission. It was this section that was mainly responsible for the compromise embodied in the Bill of last year—a compromise which has been accepted by all the bodies concerned, and which Convocation has now approved.

THE annual general meeting of the Incorporated Association of Head Masters was held on Thursday last. Resolutions were passed referring to the new regulations of the matriculation examination of the University of London, the dates of scholarship examinations at Oxford and Cambridge, and the training of teachers. At the second day's meeting of the Association, this year's president, the Rev. A. R. Vardy, Head Master of King Edward's School, Birmingham, delivered an address in which he referred to some of the more important educational work accomplished by the Association during the past year. The Rev. R. D. Swallow, in moving "That this Association approves the steps taken by its representatives at the Delimitation Conference held at the Education Department, and hereby adopts the joint memorandum as agreed to at the conference," remarked that the conference, though under the chairmanship of Sir G. Kekewich, was unofficial. It was understood by all that State aid would be needed by secondary schools if they were to take their proper place. The great aim recognised in the memorandum was that the object of secondary schools was to form character in its fullest sense. As to application of principles, the masters of higher grade schools had acknowledged that there must be differentiation. The higher grade schools accepted a place as definitely higher primary schools. These schools had also accepted the assignment of scholarships to primary and secondary schools, and claimed no exclusive use of public funds. The Association also accepted the position that, being primary, these higher grade schools should also be free. There was also a common agreement as to a central authority. After some discussion, the resolution was adopted. A resolution was also carried to the effect that Parliamentary assistance was needed both for the cost of annual maintenance and the provision and equipment of adequate buildings for secondary education.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, December 16, 1897.—"On the Thermal Conductivities of Single and Mixed Solids and Liquids, and their Variation with Temperature." By Dr. Charles H. Lees, Assistant Lecturer in Physics in the Owens College.

These experiments were undertaken with a view to determining the effect of temperature on thermal conductivities, and the relation between the conductivity of a mixture and the conductivities of its constituents. About thirty solids, liquids, substances near their melting points, and mixtures of liquids, were tested between temperatures of 15° and 50° C., and the following statements embody the results:—

(1) Solids not very good conductors of heat in general decrease in conductivity with increase of temperature in the neighbourhood of 40° C. Glass is an exception to this rule.

(2) Liquids follow the same law in the neighbourhood of 30° C.

(3) The conductivity of a substance does not invariably change abruptly at the melting point.

(4) The thermal conductivity of a mixture lies between the conductivities of its constituents, but is not a linear function of its composition.

(5) Mixtures of liquids decrease in conductivity with increase of temperature in the neighbourhood of 30° C., at about the same rate as their constituents.

"On the Biology of *Stereum hirsutum*, Fr." By H. Marshal Ward, Sc.D., F.R.S., Professor of Botany in the University of Cambridge.

The author has cultivated the mycelium of this fungus obtained from spores, on sterilised wood, and after several months the cultures developed yellow bosses which proved to be the hymenophores bearing the basidia. This fungus has not hitherto been made to produce spores in cultures, and Basidiomycetes generally have rarely been made to do so. The actions of the mycelium on the wood of *Æsculus*, *Pinus*, *Quercus*, and *Salix* are also examined, and this is, so far as known, the first time this has been done with pure cultures.

Mathematical Society, January 13.—Prof. Elliott, F.R.S., President, in the chair.—The President informed the Members of the recent decease of Signor Brioschi, a Foreign Member of the Society, gave a slight sketch of some of his work, and dwelt upon the loss occasioned by his death to the mathematical world. He then read a letter drawing attention to what was proposed to be done in founding a "Sylvester-Memorial" medal, to be awarded triennially by the Royal Society.—Mr. Love, F.R.S., communicated a paper, by Mr. B. Hopkinson, on discontinuous fluid motion; and Mr. S. H. Burbury, F.R.S., gave a sketch of his paper on the general theory of stationary motion in a system of molecules.—The following papers were briefly communicated from the chair:—Note on a property of Pfaffians, Mr. H. F. Baker; on the intersections of two conics of a given type, and on the intersections of two cubics, Mr. H. M. Taylor; on the continuous group defined by any given group of finite order, Prof. W. Burnside, F.R.S.; on those transformations of coordinates which lead to new solutions of Laplace's equation, Prof. Forsyth, F.R.S.—Mr. G. B. Mathews, F.R.S., exhibited copies of a figure connected with Prof. F. Morley's paper (on the Poncelet polygons of a Limaçon, November 11, 1897).

EDINBURGH.

Royal Society, December 20, 1897.—The Hon. Lord McLaren in the chair.—Dr. C. G. Knott read an obituary notice of the Rev. John Wilson.—Dr. Noël Paton communicated the result of a series of investigations on the life-history of salmon in fresh water. The work was carried on in the Research Laboratory of the Royal College of Surgeons, Edinburgh, for the Scottish Fishery Board, and the results will be embodied in a report to that Society. The following are the names of those responsible for the different parts of the investigation: Drs. F. D. Boyd, J. C. Dunlop, A. L. Gillespie, E. D. W. Greig, G. L. Gulland, Mr. S. C. Mahalanobis, Miss M. J. Newbigin, and Dr. Noël Paton. The objects of inquiry were: To determine whether salmon feed in fresh water; to investigate the factors causing the migrations of the salmon from sea to river, and river to sea; to study the cause of the migrations, and to investigate the chemical changes of the salmon in fresh water. With regard to the first question—Do salmon feed in fresh water?—it is shown that, in fish which have been in fresh water, changes occur in the mucous membrane of the alimentary canal, the cells undergoing degeneration, and desquamation. The digestive activity is feeble; there is a greater number of micro-organisms found in the stomach and intestines, and the proportion of putrefactive organisms is greater. This last may be accounted for by the absence of acid connected with the low digestive power. As to the second and third points of inquiry—the cause and course of migration—the changes in the weight and condition of salmon, from the estuaries and upper reaches, have been studied during the season. There is evidence that migration is not caused by the *nisus* generations but by the state of nutrition. The chemical changes which take place in salmon are interesting. There is a disappearance of solids from the muscles, which is far more than sufficient to yield the solids required by the growing ovaries and testes, and the disappearance of fat from the muscles is more than sufficient to yield the fat of the ovaries. The muscles do not undergo fatty degeneration, but fat is stored between the fibres and in the fibres, and afterwards discharged or used up. The fats are the most important source of the energy of muscular work. The "curd" is due to an excess of soluble proteids, which diminish in the muscles as the season advances. The proteid lost from the muscle is far more than sufficient to yield the proteid of the ovary and testis. The phosphorus stored in the muscles is just sufficient to yield the phosphorus of the growing ovary, but the iron stored in the muscle is not sufficient to yield the iron of the ovaries. Changes in the food value of the fish, and the nature of the pigments in the flesh and ovary are also subjects of investigation.—A note on the passage of water and other substances through india-rubber films, by Dr. R. A. Lundie, was communicated by Prof. Tait.

PARIS.

Academy of Sciences, January 10.—M. A. Chatin delivered the presidential address, in which, after some remarks on botanical classification, he gave brief accounts of the work of members and associates lost by death during the past year, MM. D'Abbadie, Des Cloizeaux, and Schützenberger. The prizes for the year 1897 were awarded as follows:—Francœur Prize, for Geometry, to M. G. Robin; the Poncelet Prize, to M. R. Liouville, for his work on mathematics and mechanics. In Mechanics, the Extraordinary Prize of six thousand francs, between MM. Gossot, Liouville, Decante, and Chéron; the Montyon Prize between MM. Bourguin, Pavie, and Pigache; and an encouragement from the funds of the Plumey Prize to MM. Brillé and Girard. The Fourneyron Prize, on the theory of the motion of bicycles, was not awarded. In Astronomy, the Lalande Prize to M. Perrine for his discoveries of comets; the Damoiseau Prize to M. Hermann Struve; and the Valz Prize to M. Louis Fabry. In Physics, the La Caze Prize to M. Ph. Lénard for his researches on the kathode ray. In Statistics, a Montyon Prize is divided between M. Gustave Bienaymé and MM. Vincent and Burot; a very honourable mention being accorded to M. Lepage and an honourable mention to M. Baudran. In Chemistry, the La Caze Prize to M. Sabatier for his researches on the sulphides of the alkalis and alkaline earths, of boron and of silicon, on the thermochemistry of the hydrated metallic chlorides, on metaphosphoric and nitrosodisulphonic acids, and on the action of the oxides of nitrogen upon metals; the Jecker Prize to M. Haller for his researches in organic chemistry, especially on the derivatives of camphor. In Mineralogy and Geology, the Grand Prize for the Physical Sciences to M. Joseph Vallot for his researches on the meteorology and geology of the High Alps and Pyrenees; the Bordin Prize to M. G. Pruvot for his works on the depth and fauna of the Gulf of Lyons, and the Delesse Prize to M. Œhlert for his paleontological work. In Botany, the Desmazières Prize to M. Jacob Eriksson for his researches on the mode of life and propagation of the numerous forms of blight which attack cultivated graminaceous plants; the Montagne Prize to M. Bourquelot for his work on the physiology of fungi, and the Thore Prize between M. Louis Bordas and M. Sappin-Trouffy. In Anatomy and Zoology, the Savigny and the Da Gama Machado Prizes are not awarded, but honourable mention is accorded to the work of Mdme. la Comtesse de Linden. In Medicine and Surgery, Montyon Prizes are awarded to M. Gaucher for his memoirs on the pathogeny of nephritis and on the diseases of the skin; to M. Zambaco for his work on leprosy in Constantinople; to MM. Rémy and Contremoulins for their Atlas of Radiophotography; and to MM. Marie and Ribout for their radiographic work. Mentions are accorded to M. Fabre-Domergue, MM. Bosc and Vedel, and a third mention to M. Lapique; the Barbier Prize is given to M. de Rochebrune for his treatise on African toxicology, and a mention to M. Lucet for his memoire on *Aspergillus fumigatus* in domestic animals and in incubating eggs; the Bréant Prize to MM. Burot and Legrand for their works on marine epidemics and on mortality in the Colonial army; the Godard Prize to MM. Beauregard and Boulart for their researches on the genito-urinary organs of the Cetacea; the Parkin Prize to Dr. Augustus Waller for his studies relating to the action of carbonic acid and other gases upon the negative variation of excited nerves; the Bellion Prize between M. Auguste Pettit for his researches on the suprarenal capsules, and M. Peron for his anatomical and experimental researches on the tuberculosis of the pleura; the Mège Prize to M. Ph. Tissié; the Lallemand Prize between M. Henri Meunier for his study of the part played by the nervous system in infection of the pulmonary apparatus and M. Gustave Durante for his work on secondary degenerations of the nervous system. Honourable mentions are accorded to M. Voisin, MM. Onuf and Collins, and to M. A. Mercier. The Baron Larrey Prize is awarded to M. Auffret for his monographs on the help to be given to the wounded and shipwrecked in maritime war. In Physiology, the Montyon Prize for experimental physiology is given to M. Delzenne for his works on the coagulation of the blood, the La Caze Prize to M. Röntgen for the discovery of a new and powerful instrument of physiological and therapeutical research; the Pourat Prize to M. Kaufmann; the Martin Damourette Prize to M. L. Guinard for his memoirs on the physiological effects of some of the opium alkaloids, and on the causes of certain accidents in anæsthesia, and the Philipeaux Prize to MM. Courtade and Guyon. In Physical Geography, the Gay Prize is accorded to M. Charles Flahault for his memoir on the study of the French Mediterranean region from the point of view of the geographical distribution of plants. Of the General Prizes, the Montyon Prize (unhealthy trades) is not awarded this year, but mentions are accorded to MM. Masure, Arnaud, and Magitot. The Cuvier Prize is given to Prof. Marsh for his geological work in the United States; the Trémont Prize to M. Frémont; the Gegner Prize to M. Paul Serret; the Petit D'Ormoy Prizes to the late M. Tisserand (Mathematical Sciences); and M. Gosselot (Natural Sciences); the Tchiatcheff Prize to M. Obrutschew; the Gaston Planté Prize to M. André Blondel; the Cahours

Prize between MM. Lebeau, Hébert, Tassilly, and Thomas; the Saintour Prize to M. G. André; the Prize founded by Mdme. La Marquise De Laplace to M. Crussard, and the Prize founded by M. Félix Rivot to MM. Crussard, Gourguechon, Bertrand, and Bruneau.

NEW SOUTH WALES.

Royal Society, November 3, 1897.—The President, Henry Deane, in the chair.—The effect of temperature on the tensile and compressive properties of copper, by Prof. Warren and Mr. S. H. Barraclough. This investigation was carried out on some fifty copper test pieces. The temperature range attained was from 25° F. to 535° F., the temperatures being measured by certified mercurial thermometers. The chief conclusions arrived at were: (*a*) The relation between the ultimate tensile strength and the temperature may be very closely represented by the equation $f = 32,000 - 21\ t$, where f is the tensile strength expressed in pounds per square inch, and t is the temperature expressed in degrees F. (*b*) Temperature does not affect the elongation or contraction of area in any regular manner: and at any one temperature the variation in these two quantities is so variable for different specimens that no particular percentage could be included in a specification for the supply of copper. (*c*) The elastic limit in tension occurs at about 5400 lbs. per square inch: this limit probably decreases rapidly with increase of temperature, but the differences in the behaviour of individual specimens are so great as to prevent the determination of the relationship between the two quantities. (*d*) The elastic limit in compression occurs at about 3200 lbs. per square inch: it decreases with increase of temperature, the relationship between the two being more regular than in the tensile tests. (*e*) The rate of permanent extension and compression increases rapidly with increase of temperature.—Aurora Australis, by H. C. Russell, C.M.G., F.R.S. This paper contained a list of auroral displays in the southern hemisphere during 1897, also a detailed account of one which was observed by the captain and officers of the R.M.S. *Aorangi*, on April 20, 1897, when the ship was in long. 96° W. and lat. 47½° S.—The basalts of Bathurst and the neighbouring districts, by W. J. Clunies Ross. In this paper the character of the basalt occurring in the neighbourhood of Bathurst, on the Bald Hills, and other hills in the vicinity, was described. Specimens from various localities have been obtained, microscopic sections cut from them, and chemical analysis made. It has been found that there are some differences in the microscopic structure of the rocks from hills close together, but the chemical analysis shows them to be all closely related. The silica was found to be about 47 per cent., but reached 50 per cent. on Mount Pleasant. The alumina, oxide of iron, lime, and magnesia were also determined. For comparison with the Bathurst basalt, which no doubt originally flowed as a lava from some centre of volcanic activity, and in order to trace the source from which it came, specimens were examined from all the places within forty miles of Bathurst, where basalts are known to occur.

DIARY OF SOCIETIES.

THURSDAY, JANUARY 20.

ROYAL SOCIETY, at 4.30.—The Relations between Marine Animal and Vegetable Life: H. M. Vernon.—(1) The Homogeneity of Helium; (2) Fergusonite, an Endothermic Mineral: Prof. W. Ramsay, F.R.S., and Morris W. Travers.—On the Modifications of the Spectra of Iron and other Substances radiating in a Strong Magnetic Field: T. Preston.

ROYAL INSTITUTION, at 3.—The Halogen Group of Elements: Prof. Dewar, F.R.S.

SOCIETY OF ARTS, at 4.30.—Recreations of an Indian Official: Right Hon. Sir Mountstuart Elphinstone Grant Duff, G.C.S.I., C.I.E., F.R.S.

LINNEAN SOCIETY, at 8.—On the Larval Hyobranchial Skeleton of the Anurous Batrachians, with special reference to the Axial Parts: Dr. W. G. Ridewood.—On the "Abdominal Pore" in the Myxinidæ: R. H. Burne.

CHEMICAL SOCIETY at 8.—Ballot for the Election of Foreign Members.—The Action of Caustic Alkalies on Amides: Dr. Julius B. Cohen and Edward Brittain.—The Formation of Monomethylaniline from Dimethylaniline: Dr. Julius B. Cohen and H. T. Calvert.—Note on the Aluminium-Mercury Couple: Dr. Julius B. Cohen and H. T. Calvert.—Action of Chloroform and Alkaline Hydroxides on the Nitro-benzoic Acids: W. J. Elliott.—Researches on the Terpenes. II. On the Oxidation of Fenchene: J. Addyman Gardner and G. B. Cockburn.—The Preparation of Pure Iodine: Dr. Bevan Lean and W. H. Whatmough.

FRIDAY, JANUARY 21.

ROYAL INSTITUTION, at 9.—Buds and Stipules: Sir John Lubbock, Bart., M.P.

PHYSICAL SOCIETY, at 5.—On Electric Signalling without Conducting Wires: Prof. O. Lodge, F.R.S.—A Tesla Oscillator will be exhibited by Prof. S. P. Thompson, F.R.S.

TUESDAY, JANUARY 25.

ROYAL INSTITUTION, at 3.—The Simplest Living Things: Prof. E. Ray Lankester, F.R.S.

ANTHROPOLOGICAL INSTITUTE, at 8.30.—Anniversary Meeting.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Reservoirs with High Earthen Dams in Western India: W. L. Strange.

ROYAL VICTORIA HALL, at 8.30.—Mars as a World: R. A. Gregory.

THURSDAY, JANUARY 27.

ROYAL SOCIETY, at 4.30.

ROYAL INSTITUTION, at 3.—The Halogen Group of Elements: Prof. J. Dewar, F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Notes on the Electro-Chemical Treatment of Ores containing the Precious Metals: Major-General Webber, C.B.

FRIDAY, JANUARY 28.

ROYAL INSTITUTION, at 9.—Instinct and Intelligence in Animals: Prof. C. Lloyd Morgan.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Condensing Apparatus: H. Williams.

BOOKS RECEIVED.

BOOKS.—The Tutorial Chemistry: Dr. G. H. Bailey. Part 2. Metals (Clive).—On a Sunshine Holyday: The Amateur Angler (Low).—Nature's Diary: F. H. Allen (Gay).—An Elementary Course of Practical Organic Chemistry: F. C. Garrett and A. Harden (Longmans).—The Essentials of Experimental Physiology: Dr. T. G. Brodie (Longmans).—Premature Burial: Fact or Fiction?: Dr. D. Walsh (Baillière).—The Tailless Batrachians of Europe: G. A. Boulenger, Part 1 (Ray Society).—A First Year's Course of Experimental Work in Chemistry: Dr. E. H. Cook (Arnold).—Views on some of the Phenomena of Nature: J. Walker (Sonnenschein).—Korea and her Neighbours: Mrs. Bishop, 2 Vols. (Murray).—United States Geological Survey, Monographs xxv.-xxviii (Washington).—Annuaire de l'Académie Royale des Sciences, &c., de Belgique, 1898 (Bruxelles).—The Purification of Sewage and Water: W. J. Dibdin (Sanitary Publishing Company, Ltd.).—Proceedings of the Chemical and Metallurgical Society of South Africa, Vol. 1 (Edinburgh. Hunter).—Audubon and his Journals: M. R. Audubon, 2 Vols. (Scribner).—The Observer's Atlas of the Heavens: W. Peck (Gall).—The War of the Worlds: H. G. Wells (Heinemann).

CONTENTS.