THURSDAY, JANUARY 2, 1902.

THE PHYSIOLOGICAL EFFECTS OF ROUTE MARCHING.

Studien zu einer Physiologie des Marsches. By Dr. Zuntz, Professor of Physiology in the Royal Agricultural College, Berlin, and Dr. Schumburg, Oberstabsarzt 1st Cl. and Privatdocent, Hanover. (Vol. vi. of the *Bibliothek von Coler, Sammlung von Werken aus dem Bereiche der Militär-medicinischen Gebiete.* Edited by O. Scherning.) Pp. viii + 361, and one chart. (Berlin: August Hirschwald, 1901.)

THE "Bibliothek v. Coler" was commenced in March last to celebrate the seventieth anniversary of the birth of Generalstabsarzt Alwin v. Coler, who held the post of Director-General of the Army Medical Service in Germany from the year 1889 until his death in September last. V. Coler was intimately associated with the development of that service ever since its foundation in 1868, and it may truthfully be said that the fine *esprit de corps* which exists in it to-day, and which is characterised by a determination to maintain a high standard of culture and scientific attainment amongst its members, is due to his influence. The collection of works which have been called after him admirably demonstrates what this influence meant. It is edited by Generalarzt Otto Scherning, v. Coler's colleague and ally, and some twenty-six volumes are already announced. They are an excellent expression of the scientific work of the German Military Medical Service, as carried out under v. Coler's guidance and inspiration, as well as of the intimate relationship that exists between army doctors and the teaching professors in Germany.

The authors of the volume under review are well known. Prof. Zuntz's previous work on metabolism is authoritative, and Dr. Schumburg has acquired a wide reputation for original investigations on a variety of military medical subjects. The volume is a record of careful and elaborate observations, made by them, on the physiological effects of route marching. In some of their experiments, notably those involving complicated chemical analyses, they were helped by Prof. Munk, Dr. Nichter, Dr. Frenzel and others.

The introductory chapter is an historical sketch of previous anatomical and physiological work in the same direction from the time of Fabricius de Aquapendente, Gassendi and Borelli to the more modern investigations of Marey, Vierordt, Braune and Fischer. This *résumé* is fairly complete and interesting, but the work done in England is not well represented.

The remaining chapters are an account of the authors' own observations and are of exceptional interest and merit. Five students of the Kaiser-Wilhelm-Academie (formerly known as the Friedrich-Wilhelms-Institut), the cadet school for medical students destined for the military medical service of their country, volunteered for the experiments. During April, May, June and July they marched, at frequent intervals, a distance of 24·75 km. without altering the route or the pace. The marches were commenced, as a rule, at 7 o'clock in the morning, occasionally at 5 o'clock, and two halts were made, one of ten minutes and the other of half an hour for breakfast. The service uniform and accoutrements were worn, and, with the exception of the weather, the only variation in the condition of the marches was in the weights carried. In fact, the experiments were conducted to determine the limit of weight which the soldier can carry without interference with his capacity for striking, and striking hard, at the end of a day's march. Both authors were members of a German War Office committee appointed to decide this point by physiological experiment in 1894, and, although the observations recorded in this volume were conducted during that year, they do not appear to have been made public until now.

It would be difficult in a short review to detail all the points of interest in the volume. They are many. Several of the more important scientific details are contained in tables interspersed throughout the text or brought together in appendices. If the headings of the columns of figures in these tables indicated more precisely what the figures represented, the physiologist would be able to study the records and draw his own conclusions from them without much difficulty. Unfortunately, this is not always the case, and it is often impossible to follow the tabulated records without closely reading the text; and, as is apt to be the case in German works of this kind, the latter is full of argument, comparisons and historical comments which tend to confuse the simple statements of fact. At the same time, it is only fair to say that these interpolations are well-balanced criticisms of the results of the experiments, and that the authors' conception of their own laborious work is dignified and modest in the extreme.

The extent of this work may be estimated from the fact that immediately before and after each march, sometimes during the march and on days of rest, careful examination was made of all the organs and functions of the body that were likely to be influenced by the carrying of a heavily loaded knapsack. This included sphygmographic tracings, enumeration of blood corpuscles, estimation of the specific gravity of the blood, experiments on the reaction of muscles and nerves, measurements of vital capacity and records of variations in urinary constituents. These formed one series of observations only. A second and more complicated series was carried out, in the case of two of the students only, in order to determine the effect of the marches on metabolism, and one must be content to present here a few of the practical results of these investigations without attempting to exemplify the full extent and scope of the work.

After graduated marches with lighter weights, the students were made to carry knapsacks with loads of 22, 27 and 31 kg., and the physiological effects of the lightest, intermediate and heaviest of these loads were compared.

The general condition of the students improved, excessive fat disappeared, while the body-weight was reduced by 1·5 to 3·5 kg. The sphygmographic tracings showed that cardiac systole was prolonged and diastole shortened as the weights carried were increased. This is exemplified by the use of a quotient derived from the formula $\frac{D}{S}$, where D represents the durations of the diastole and S that of the systole in

1/100ths of a second. The mean of the observations made this quotient = 1·73 with a 22 kg. load, 1·58 with 27 kg., and 1·47 with 31 kg., while the lowest quotient of $\frac{D}{S}$ recorded during rest was 1·88 and the highest 3·28. The effect of heavy marches on the systole and diastole of the heart was, therefore, as the authors express it, undoubted. They attribute the result to fatigue of the cardiac muscle and consider that, if the load is raised beyond 31 kg., permanent damage to the heart may result. They also noted that the pulse increased to 140 and 150 beats per minute and that dicrotism became marked as the quotient of $\frac{D}{S}$ approached unity.

Another important and unexpected result was that in a series of eighty-nine observations the cardiac area of dulness showed marked increase in sixty-four and the hepatic area in sixty-seven instances after the march. This increase was noted in 56 per cent. of the observations after a march with 22 kg., in 70·4 per cent. with 27 kg. and in 87·5 per cent. with 31 kg.

Still more important is the observation that the increase in the area of dulness was due to dilatation of the right and not of the left side of the heart, and that it is produced by a general stagnation of the venous circulation. The authors designate the phenomenon "march dilatation of the right side of the heart."

These observations on the cardiac function are new and well worth noting. They have special significance for the military medical officer, as they throw a new light on the condition known as "disordered action of the heart," which is a common sequel of military training and the cause of a considerable amount of invaliding in the British Army.

The observations on other organs and functions did not produce quite such interesting or positive results. The specific gravity of the blood was only increased by ·006 and the red blood corpuscles by 9 per cent. after the heaviest march. An apparent increase of 43 per cent. in the white corpuscles was due to polynuclear cells being carried into the circulation from the walls of the larger veins, in consequence of increased cardiac action; but the blood resumed its normal condition on the day following the march.

The vital capacity of the lungs was studied by means of an experimental gas meter, into which a number of expirations was made in succession, and the volume indicating vital capacity determined by dividing the total record by the number of expirations. This was considered more accurate than records given by Hutchinson's spirometer. Sixty-nine observations were made during marches with loads and eighty-nine during marches without loads. The practical result was that, up to a certain point, the graduated training of the soldier increased his vital capacity, but that a marked diminution occurred in marches with the heaviest loads, this serious result being associated with the dilatation of the heart and liver and the venous stagnation already noted. Another practical observation was that the increase in frequency of respiration, which is invariably associated with exercise, gradually falls to normal during halts, but that when dilatation of the right side of the heart had become well marked, this increase remained as high as 40 per cent. above the normal even after a halt of 30 minutes. The authors conclude that frequency of respiration exceeding 28 per minute, or 75 per cent. increase on the normal, with a gradual fall to 30 per cent. above normal after a quarter of an hour's halt, is the limit which can be borne by a soldier of average strength without breakdown.

The observations on the effect of the marches on body temperature are comparatively brief, but the subject of the regulation of heat and the calorific value of the work done forms a complicated series of calculations and experiments introduced into the chapters which are devoted to the study of metabolism. The authors estimate that the heat production of the work done in marching is sufficient to raise the body temperature 1° C. in 8·7 minutes. In the direct observations there was an actual increase of temperature of 1° to 1°·5 C. only, after the heaviest marches. As the surface cooling resulting from the evaporation of sensible and insensible perspiration plays so important a part in maintaining heat equilibrium, the authors rightly emphasise the importance of attention being paid to the material and nature of the soldiers' clothing with a view to avoiding interference with this function of the skin.

Experiments on the influence of the marches on the nervous system and on muscles were unsatisfactory. Observations were made on the "reaction period," and ergographic tracings were taken with Mosso's apparatus. The results in both cases were inconclusive and conflicting, weather, individual disposition, auto-suggestion, all helping to bring this about. An attempt was also made to estimate the effects of the marches on the nervous system by some ingenious memory tests, but they were so influenced by the drowsiness consequent on the early morning start that the after results were quite inconclusive.

Some interesting facts are recorded in connection with the renal function. Notwithstanding the great loss of water by perspiration, there was no increase in the specific gravity of the urine. Thus the average specific gravity in 150 observations before the march was 1023·6, and after the march 1021·7. This convinced the authors that marching has a diuretic effect, and they recall similar observations by Oertel and Henschen. Their observations on albumin in the urine are also contrary to the general impression, an impression no doubt derived from the observations of Albu and of Macfarlane, that during hard physical exercise transient albuminuria occurs. Zuntz and Schumburg found nothing of the kind amongst their five students, and they point out that Benedicenti had made similar observations on soldiers.

The series of observations and experiments on metabolism includes analysis of nitrogenous waste, respiratory changes, calorific value of the work performed, and the regulation of the body temperature. The observations are of an elaborate and complicated character, and only two of the five students were submitted to experiment. The chief practical results may be briefly noted.

The elimination of nitrogenous products both by the skin and kidneys was not markedly influenced by the marches. When increase did occur, it occurred on the day following the march, and not during or immediately

after the march. The calculation of elimination by the skin was made by careful analysis of the underclothing. The average amount was found to be 284 mg. per litre of perspiration, and as the perspiration increased the proportion of nitrogen eliminated diminished. Thus 2069 grms. of perspiration contained 0·308 per cent. of nitrogen, while 3447 grms. contained only 0·243 per cent. The number of observations on this point was few, and the results suggest the need of further investigation.

In estimating the respiratory changes, the authors made use of the "*tret-werk*," a rolling platform worked by machinery so as to move backwards at the same rate as the individual walking upon it moves forwards. In this manner he remains constantly at the spot where the apparatus for measuring the respired air is fixed. The two students marched on this "*tret-werk*" for six to eight minutes immediately after each march, and for eight to ten minutes during periods of rest, with and without the knapsack. The influence of the marches on the respiratory changes was determined by the "respiratory quotient," *i.e.* the quotient derived by dividing the volume of CO_2 expired by the volume of O inspired. This quotient is equal to unity in the case of herbivorous animals, who obtain their carbon from carbohydrates only and not from hydrocarbons. In carnivorous animals the necessity of using some of the oxygen for the oxidation of the hydrogen in the hydrocarbons, which they consume, diminishes the volume of CO_2 expired in proportion to the oxygen inspired, and the quotient in their case is consequently expressed by a fraction of unity. The authors make use of this fact and show that the "respiratory quotient" is a constantly diminishing fraction after heavy marches. In other words, the carbohydrates are very quickly used up, leaving the fats only as energy-producing material. They conclude from this that, in continuous heavy marching, the carbohydrates consumed in the rations are not sufficient to replace the waste, and that a day's rest is required after every three days' marching to enable the body to recover its normal power.

There are many other points in this volume that are suggestive and of practical importance in military training and in military operations, and it must be regarded as one of the most important works that have been published with reference to several questions that arise in connection with military hygiene. The German military authorities, at any rate, have accepted the conclusions as authoritative, and the regulations bearing upon marching and physical training in Germany are evidently inspired by them. W. G. M.

LIVES OF THE HUNTED.

The Lives of the Hunted. By Ernest Seton-Thompson. Pp. 360. (London: Nutt, 1901.) Price 6*s.* net.

'LIVES OF THE HUNTED" is practically a second volume to the first of three books noticed in a general review of Mr. Seton-Thompson's work lately published in NATURE (p. 25), "Wild Animals I have Known." When a book has earned a well-deserved success, the temptation to the author to write another on the same lines is strong. But sequels of the kind are seldom as good as the originals, and this is no exception to the rule.

Mr. Thompson is so well up in his subjects that nothing that comes from his pen or pencil can be without interest. The full-page illustrations—more particularly those of the bears in the Yellowstone Park and the big-horn ram facing the wolves—are excellent; but, with some exceptions, neither the letterpress nor the marginal sketches are quite on the level either of the book named above or of the "Biography of a Grizzly."

Unfortunately, too, the little pitted speck noticeable in his earlier writings—more especially in "The Trail of the Sandhill Stag"—a tendency to a rather sickly sentimentality, has grown to disfiguring proportions, and in his last production is a serious blemish.

"The preservation of our wild creatures," to which the book is dedicated, is a worthy object. But it is doubtful whether it is likely to be substantially helped by suggestions, if not actual arguments, which, in spite of Mr. Thompson's assurance that he does "not champion any theory of diet," can only, if pushed to their logical conclusions, mean that mankind is in duty bound to give up eating meat and turn vegetarian. The sneer at "the Saxon understreak of brutish grit, of senseless, pig-dogged pertinacity," which made the old huntsman Scottie stick to the trail of the great ram until the coveted head and horns were his—the race-quality, by the bye, which has helped more, probably, than any other to raise the United States as well as England to the positions they hold among the nations—may appeal, perhaps, to some of his readers, but to others less emotional it may seem a little silly.

"Wolfish human brute" is rather a "brutal" summing-up of the character of the plucky old stalker, whose actual name is given, to come from the pen of a writer who, according to his own account, was not, in trapping days, foolishly over scrupulous.

But when he leaves "gush" and sentiment behind him, and, warming to his work, writes in the bright, unpretentious style which is more natural to him of the things he has seen and known, Mr. Thompson is well worth reading.

"Johnny Bear," the third story in the collection, is a simply-written and charming description of the ways of the bears he studied closely in the Yellowstone Park, and even more delightful, perhaps, is the account he gives of the home and habits of the fairy-like kangaroo rat,

"the loveliest, daintiest fawn-brown little creature ever seen in fur," with "large beautiful eyes . . . innocent orbs of liquid brown; ears like the thinnest shells of the sea, showing the pink veins . . .; hands the tiniest of the tiny, pinky-white and rounded and dimpled like a baby's."

Sentiment notwithstanding, Mr. Thompson dug out and explored, and in the margin gives a plan of the little creatures' underground establishment, which was safely protected from the attacks of coyottes and other miscreants by the spiked leaves of an overshadowing "Spanish bayonette" bush. It is engineered on much the same general lines as the breeding nest of a mole, with

the addition of granaries for dried seeds—the different sorts kept separately—and with more blind passages. In place of the leaves with which a mole fills its more roughly constructed inner sanctuary, the kangaroo rat's nest was lined with "a thick felting of fine grass and weed silk, and, inside all, a lining of softest feathers." "I think," he writes, "that every gay little bird on the plains must have contributed one of its finest feathers to that nest."

Among the best passages in the book are those in which Mr. Thompson in his first chapter reads the records of the old ram's long life in the gravings of his horns. The deep dent tells of the early battle in which he won his spurs. The two dark-coloured, wrinkled rings close together lower down are reminders of the years of starvation and the sickness which carried off the weaker members of the flock, and the bolder ridges wide apart recall the prosperous years that followed.

He has much to tell that is worth learning, and, left to himself, can tell it excellently. It will be a misfortune to many lovers of natural history besides himself if Mr. Thompson is beguiled into sacrificing himself on the shrine of the admirers who, as he tells in his preface, "bitterly denounced" him for confessing that in unregenerate days he was not above killing a dangerous wolf when he could. T. D. P.

CUBIC AND QUARTIC CURVES.

An Elementary Treatise on Cubic and Quartic Curves. By A. B. Basset, F.R.S. Pp. xvi + 255. (Cambridge: Deighton, Bell and Co., 1901.) Price 10*s.* 6*d.*

NOW that Salmon's "Higher Plane Curves" is out of print there is undoubtedly room for a good book on the subject. The purpose of such a book would be to give students who had read conic sections and the infinitesimal calculus a good knowledge of the main lines on which the theory of curves has been developed. The bookwork would contain discussions of the chief theorems; those of less importance would be given as examples, and would furnish the student with abundant matter for independent thought. The proofs given would, so far as possible, be models of rigour and elegance, and in the rare cases where rigour was sacrificed for the sake of simplicity this would be confessed. The book before us has not been written altogether on these lines. There are no examples, and a great deal of space is taken up in proofs of the properties stated that could, in our opinion, have been put to better use; moreover, the proofs given are not always satisfactory, and even the theorems themselves are sometimes wrongly stated.

After two introductory chapters, chapter iii. deals with tangential coordinates, reciprocal polars and foci, chapter iv. with Plücker's equations. Then we have a chapter on "cubic curves" (pp. 56–73) and another on "special cubics" (pp. 74–96). The special curves discussed are circular cubics, and in particular some that are the inverses of conics, the semicubical and cubical parabolas, the folium of Descartes, the witch of Agnesi. Chapters viii., ix., x. are respectively on "quartic curves" (pp. 101–132), "bicircular quartics" (pp. 133–161), "special quartics" (pp. 162–204). Non-singular, or, as the author prefers to call them, anautotomic quartics, receive attention for three pages only (115, 117, 122). The special quartics discussed are the cassinian, the lemniscates of Bernoulli and Gerono, cartesians, limaçons, the cardioid and the conchoid of Nicomedes. Chapter xi. treats of "miscellaneous curves," roulettes, the evolute of an ellipse, the involute of a circle, the catenary, tractory, elastica and spirals. Chapter xii. is on projection. Some useful references are given in footnotes.

The author has not found space for any general discussion of the forms of cubic and quartic curves, or of the expressions for the coordinates of a variable point on a curve in terms of a parameter, even when the curve is unicursal. The theory of residuation is not mentioned. The following are some of the matters of detail in which the book might be improved.

It is a good thing to "give special prominence to geometrical methods," but we do not think it is sound to estimate, say, the number of tangents that can be drawn from a cusp, real or imaginary, by inspection of the figure (p. 18), especially when no discussion of the form of a curve near a real cusp has been given; the question is in its essence an algebraical one and cannot really be decided except on algebraical grounds.

A process is given (§ 2) for finding the eliminant of two binary quantics of degree n. The result would be of the degree 2^n in the coefficients.

The condition given on p. 4 for the equality of r roots of an equation would lead us to conclude that the equation $3x^4 - 4x^3 + 1 = 0$ has three equal roots.

In the proof of Plücker's equations (chap. iv.) it is only shown that m cannot exceed $n(n-1) - 2\delta - 3\kappa$, and that ι cannot exceed $3n(n-2) - 6\delta - 8\kappa$. It is not proved that the curve and the Hessian meet only at multiple points and points of inflexion.

On p. 62 it is proved that the node of a nodal cubic is a pole of the line of inflexions. The author must have forgotten for the moment that the node is a pole of any line whatever in the plane.

Cayley's theory of conjugate poles on the Hessian of a cubic is treated by means of trilinear coordinates; the figure on p. 70 does not altogether correspond with the text, for it is proved that K lies on the line PQ and that C(AMBK) is a harmonic pencil. Also it is surely wrong to say that when "A is given, there are in general three conjugate poles corresponding to A" (p. 71).

The proof (p. 115) that a quartic cannot have more than eight real points of inflexion is very flimsy; it consists of an appeal to an extreme limiting case.

The assumption that a ternary quartic can be put in the form $lU^2 + mV^2 + nW^2$ is justified by counting the constants (p. 117), although later (p. 240) the reader is very rightly warned "that counting the constants is not always a safe process."

On p. 122 we have the theorem:—

"A conic can be drawn through the eight points of contact of any four double tangents to a quartic." It is well known that this is not true, and it is, in fact, inconsistent with the theorem at the foot of the same page.

There are some other points on which we do not agree with the author, but notwithstanding its drawbacks, the book contains much that is interesting and important.

OUR BOOK SHELF.

Pharmacopedia, a Commentary on the British Pharmacopoeia, 1898. By Edmund White, B.Sc. (London), F.I.C., Pharmaceutist to St. Thomas's Hospital, London, and John Humphrey. Pp. xv+696; 46 plates. (London : Henry Kimpton, 1901.)

THE subject of materia medica is already somewhat unnecessarily complicated in its terminology ; the student has to learn the meaning of a formidable array of words before he can even define the subject-matter of his studies. *Inter alia* we may mention pharmacology, pharmacognosy, pharmaco-dynamics, pharmacy, pharmaceutical chemistry, &c. Into this sea of shibboleths the authors of this work have flung yet another which doubtless they hope will float, viz. Pharmacopedia ; this in its turn will probably produce Pharmacopedies ; by it the authors understand "information about drugs." We venture to think that one of the few mistakes of the book is its title.

The book consists of a full description, either botanical or chemical or both, of all the officinal drugs in the pharmacopœia of 1898, and their preparations. The drugs are treated in alphabetical order, and in this order also the different kinds of preparations are considered generically. The authors have rightly devoted space liberally to the chemical problems involved in the preparation of medicines. They have also discussed at length most of what is known concerning the chemistry of the alkaloids, enlarging this in many cases to a detailed account of the organic chemistry, not only of the substances immediately under consideration, but also those through which their molecular constitution has been ascertained. We may, however, remark parenthetically that we think coniine and digitalis have been treated in this respect a little scantily.

The new synthetic remedies, *e.g.* antipyrin, phenacetine, saccharine, are, so far as their chemistry is concerned, treated very fully, and this will add very greatly to the value of the book. The general remarks upon the oils, methods of standardisation, &c., are also very good and will prove useful to the student.

The book concludes with notes on the Indian and Colonial addendum of 1900 and with numerous well-executed plates of medicinal plants.

The book is well got up, and, as a book of reference like this ought to be, is actually bound, not, as is so often the case, merely enclosed in cloth covers. The authors are distinctly to be congratulated upon the result of their labours and may certainly consider that they have produced the most complete commentary upon the pharmacopœia, from the point of view of the student of pharmaceutical chemistry, in the language. The reviewer would suggest to them that in the next edition they should include once under each drug a brief account of its action and uses, and also its dose. This could be done without appreciably increasing the bulk of the volume and would add immensely to its practical value. F. W. T.

Practical Exercises on Sound, Light and Heat. By J. S. Dexter, B.Sc. Pp. xv + 284. (Longmans, Green and Co., 1901.) Price 2*s.* 6*d.*

THIS book contains elementary exercises, and is of a standard suitable for the work of science and continuation schools and for junior university students. It contains 218 sections dealing with the three subjects, so that the field is covered very completely.

The experiments on heat commence with some to illustrate the sensation of touch used as a thermoscope, and an account, which the student is recommended to take as a guide, is given of the observations. The account begins : "From this lesson I learn that my sensation of touch must not be relied upon to tell me the true heat state of the body I am examining. The thermometer given me to use made no indications of change when placed on different articles, such as wood, iron, or duster, and yet I have different sensations on touching them. . . ." The present writer feels that it would be better for the students, however young, to learn at once the normal English method of recording results and conclusions. He would put the observations first and the conclusion afterwards and avoid the personal pronoun, so that the example for the student would read thus: "A thermometer made no indication of change when placed on the following articles wood, iron or duster, but the sensation to touch was different in each case. . . . From these observations it appears that the sensation of touch cannot be trusted to indicate the heat state of a body."

The methods described by the author for many of the experiments are very simple and satisfactory. We may mention the method of measuring the coefficient of expansion of a rod, and the numerical results show that a good degree of accuracy can be attained. We should, however, have liked to have seen a chapter on the discussion of the value of the errors in the methods. It is not well that students should learn to measure one quantity to five significant figures, another to three and to multiply the two, obtaining a result with eight as we see on p. 47. S. S.

Die heterogenen Gleichgewichte vom Standpunkt der Phasenlehre. Von H. W. Bakhuis Roozeboom. Erstes Heft : Die Phasenlehre—Systeme aus einer Komponente. Pp. xiii + 221. (Braunschweig : Vieweg und Sohn, 1901.)

THIS book will receive a warm welcome from all interested in the phase-rule. Prof. Bakhuis Roozeboom has made the experimental portion of the subject peculiarly his own, and now lays chemists under an obligation of gratitude for a clear and systematic account of Gibbs's rule and its applications. The work is divided into sections according to the number of components in the systems considered, and then further subdivided according to the number of phases in the systems. This method of classification is very advantageous for detailed treatment, especially when many illustrative instances are given, as is here the case. The present section of the book, after a brief general sketch of the nature of the phase-rule, deals with systems containing only one component, the remarkable amount of interesting material collected and classified under this heading showing very strikingly the value of the rule for systematic purposes. Amongst the subjects treated we find the ordinary equilibria of solids, liquids and gases, isomerism, rate of crystallisation, critical points, triple points, transformation points and curves, liquid crystals, enantiotropy—all fully illustrated by examples and with indications of the experimental methods employed. Graphic methods are freely used in the exposition, and only the most elementary acquaintance with mathematics is required for the perusal of the systematic portion of the work. Two other sections are promised, dealing with the equilibrium of systems containing respectively two and three components. J. W.

Knowledge Diary and Scientific Handbook for 1902. Pp. 112+408. (London : *Knowledge* Office.) Price 3*s.* net.

AMATEUR astronomers and other observers of natural phenomena will find it a convenience to possess this diary and handbook. There are, in addition to the 408 blank pages of the diary, several descriptive articles on aspects of astronomy, botany, microscopy and meteorology ; star maps ; diagrams of paths of the chief planets in 1902 ; collections of tables of service to students of science ; a monthly astronomical ephemeris ; and other information of interest.

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.*]

Kites and Wireless Telegraphy.

IN view of the current report in the daily Press that Mr. Marconi has succeeded in receiving at St. John's, Newfoundland, by means of a wire raised with a kite, signals sent from his station at Poldhu, Cornwall, it may be interesting to recall that kites were used here during the summer of 1899 in some similar experiments. In the "Report of S. P. Langley, Secretary of the Smithsonian Institution, for the Year ending June 30, 1900," it is stated on p. 10: "In addition to the above investigations a Hodgkins grant has been approved to enable Mr. Rotch to carry on a series of experiments in space telegraphy, it being thought that the unprecedented heights attained by kites might materially extend the range of communication by this method. In the preliminary experiments, however, kites were not used, sufficient elevation being attainable without them, but when the difference between the stations was increased from one mile to three, kites were employed to raise the transmitting and receiving wires. In the later experiments it was found, not unexpectedly, that the long wires, carried up and supported by kites, collected so much electricity as to interfere with and greatly complicate the messages sent from station to station. These interruptions seem to show that the limit of elevation for the receiving wire was under these conditions less than five hundred feet. The greatest distance covered in the experiments was approximately twelve miles, from a wire supported by a kite about two hundred feet above Blue Hill to the tower of Memorial Hall in Cambridge, which was used as the receiving station. These experiments draw attention to the fact that electrification increases with the altitude to which the wire is carried, and that it is always present, although varying with the meteorological condition of the atmosphere. The experiments were discontinued in the autumn of 1899."

If Mr. Marconi, by his system, has really received signals from across the Atlantic, with the receiving wire lifted by a kite to an altitude exceeding five hundred feet, it would appear from my experiments that he must have employed some hitherto unknown method of shunting out atmospheric electricity.

A. LAWRENCE ROTCH.

Blue Hill Meteorological Observatory,
Mass, U.S.A., December 17, 1901.

Poisonous Molluscs.

I NOTICE that doubt is cast on the opinion held by some authorities that the bite of certain species of Conus is poisonous; and as a case has now occurred here in a European subject whose intelligence places her account of it beyond question, I think it may be useful to represent the corroborative evidence thus obtained.

I should mention, first, that a shell exactly similar to the one in question was forwarded to the Australian Museum, Sydney, and that I am indebted to Mr. Etheridge, the curator, for information on the point and for the identification of the specimen as the shell of *Conus geographicus*.

The patient, Mrs. B., was fishing from a boat after dark in the harbour of Levuka (Fiji), and one of the crew handed her a mollusc he had picked up in shallow water at low tide while getting bait—a *C. geographicus*. Mrs. B., being an old resident in the islands, proceeded to evulse the mollusc with her little finger, the boy having cracked the shell to facilitate this procedure. While doing so she received a puncture, and shortly afterwards felt her hand and fore-arm becoming numb. The effect quickly extended to the shoulder, and the patient had to return to the shore and be conveyed home. In an hour or so she was in great distress, speechless, and paralysed in most of the voluntary muscles; a condition which later became intensified and alarming, although the cardiac and respiratory muscles showed no evidence of flagging. The medical man who attended Mrs. B. likened her condition to that which might be looked for after poisoning by *curare*.

The puncture was so slight as to be scarcely discernible; after two days a steady but slow recovery took place, and a fatal termination was averted.

During this time the patient did not lose consciousness; but there was for a while some confusion of ideas, and, chiefly in consequence of the loss of power in the muscles concerned in articulation, she was unable to speak intelligibly, although she subsequently asserted that she knew quite well what was going on around her. She underwent an attack of conjunctivitis a few days later, which she connects with the occurrence; but it is doubtful whether she is right or not in so believing.

R. GLANVILL CORNEY.

Medical Department, Fiji, September 30, 1901.

The Distance of Nova Persei.

IT appears to me that the phenomenon of the apparent expansion of the nebula surrounding Nova Persei would be simply explained by referring it to the illumination of meteoric matter by the light sent out on the occasion of the outburst of the Nova. On this hypothesis it becomes possible to calculate the distance from the earth by means of the observed angular growth of the illuminated ring which must spread out with the velocity of light. This gives 313 light-years as the distance.

Daramona. W. E. WILSON.

Colours of Butterflies not due to Diffraction.

SOME time ago your correspondent, Mr. Benham, corrected the mistake that mother-of-pearl owes its beauty to diffracted light. The error had lived long, partly, perhaps, because it came from an authority so eminent as Sir David Brewster.

A similar idea seems to be still prevalent, that butterflies and moths derive their colours from diffraction. Two of the best modern natural histories, which I have at hand, favour the supposition.

The patches on the wing are groups of uniformly coloured scales, which contain pigment. Diffraction colours are of a different character; they are many-coloured iridescent lights varying as they glance off at different angles. The distinction is familiar to a worker in optics; it is easy for anyone to appreciate it by seeing recognised forms of diffraction. I have lately examined a collection of British Lepidoptera, and found no specimens which were coloured by wave interference. The Purple Emperor has two uniform colours, grey and purple, so arranged that there is a direction of vision favourable for seeing each colour. Shot silks and Labrador spar are cases somewhat similar. I have before me a foreign Thecla which has a brilliant light-blue pigment; perhaps in this and some others a certain shimmer is added by a slight diffraction interference, but the predominant effect is the blue colouring matter.

It is, however, interesting to note that all scales have fine diffraction rulings. These lines, as in the case of diatoms, consist of rows of small spots. I have had a wing of the Small Tortoiseshell for about twenty years; the scales are complete, but the colours are faint, and the wing is partly transparent. It is possible to arrange this with care in a strong light so that brilliant rainbow lights are seen, but they are not the familiar tortoiseshell pattern. This effect does not seem to be possible with a fresh wing, so that I doubt whether butterflies are often seen to act as diffraction gratings. No doubt some insects show interference colours, but these seem usually to arise from the phenomenon caused by thin plates. Diffraction can be well studied in humming-birds; there are the brilliant, ever-varying lights, and the fine markings on the feathers may be seen with a microscope. No iridescence is more delicate than that on the side of a fresh mackerel. I am not quite sure to which class of wave interference this is due. W. B. CROFT.

Winchester College, December 30, 1901.

The Quadrantid Meteors.

NOT the least important of our annual star showers are the Quadrantids, so called from the position of their radiant in the constellation of Quadrans Muralis, which is situated between Boötes and Draco. This meteor-system

has not had the same attention lavished on it as has been given to the more historic epochs of the Leonids, Lyrids and Perseids. Yet occasionally, even when only moderately active, the Quadrantid Radiant furnishes displays of about 40 meteors per hour. In the year 1839 Herrick drew attention to the recurring character of a meteor shower on January 2. A stimulus was given in the same direction when in 1839 Quetelet published his valuable contribution to meteoric literature in his "Catalogue des Principales Apparitions d'Etoiles Filantes," in which were cited two instances when meteors were reported to have been unusually numerous on the morning of January 2, viz. in 1835 and 1838. There was also a previous account of the appearance of an extraordinary bolide in the north of Italy in the year 1825, on the morning of January 2 at 5 o'clock, before and after which hour on that night there was noticed a great abundance of meteors.

When Quetelet published a second edition of his work a few years later it contained notices of Quadrantid displays on the same day of the month in the intervening years 1839 and 1840. Their observation in those years, however, may have been due to their having been specially looked for. The next notable display occurred in 1862, and was accidentally witnessed on the morning of January 2, between about 4 and 5 o'clock, by a lady residing in Harford, Connecticut, U.S., who on this occasion seems to have had the honour of being the sole observer of the apparition. Her attention was attracted by a luminous cloud moving from west to east, and also by the appearance of fine meteors at the rate of about three per minute. Two years later there occurred another display in England, on the night, however, instead of the morning of January 2, for which an organised watch had been kept. Profs. Herschel and Gregg (British Association Report, 1864, p. 30) each observed fifty shooting stars from different stations during the hours 10 to 12 p.m. and 10 to 1 respectively, while another observer, Mr. W. H. Wood, reckoned that the Quadrantids were appearing at the rate of one per minute during the hours 12 to 2. Prof Kirkwood, who instituted researches respecting the periodicity of these meteors and also of other meteor-systems, showed in a paper read before the American Philosophical Society in 1873 that the Quadrantid maximum recurred every thirteen years, the principal displays having taken place in 1825, 1838 and 1864. The intervening maximum between the two last dates is supposed, of course, to have passed unnoticed.

The expected shower, however, in 1877 was looked for in vain owing to unfavourable weather, but on the morning of January 2 in the following year, during a brief interval of clear sky beginning at 4 o'clock, Prof. Herschel noted the appearance of seventeen Quadrantids, nearly half of which ranged in brightness from the brilliancy of Sirius to that of second magnitude stars. Weaker apparitions from the Quadrantid radiant also occurred on the nights of January 2 in the years 1872 and 1873, but seem to have been only partially or imperfectly observed. The circumstance that the principal appearances of these meteors evidently took place in 1825, 1838, 1862 and 1864, and (probably) also in 1878 naturally leads to the expectation that another fine display may be observed in 1902. An examination of the dates at which the first three of these showers occurred shows that the Quadrantid meteoric epoch is gradually, as in the case of other well-known star showers, advancing into the year. The advance takes place on the average, however, and is not very noticeable over short periods, being warped by fluctuations in the date of the shower's appearance with respect to the mean date, such fluctuations being produced by the perturbations which occur in the meteoric orbit.

The display in America in the year 1862 and also those on the night of January 2 in 1872 and 1873 illustrate this advance. A calculation made by the writer with such data as the above displays afford shows that the time of the next shower's expected appearance falls on the night of January 4 in 1902, the maximum or centre of the display being due at 3h. 30m. on the morning of the 5th. Earlier in the night, shortly after 12 o'clock, meteors will probably be unusually numerous. The display in 1864 evidently did not attain the brilliancy of the previous displays. Calculation shows that the maximum of this shower occurred about 10 p.m. on the night of January 2, which prevented the shower being fully observed. Probably some early Quadrantids of the expected display will appear on the morning and also early on the night of January 3. The lateness of the maximum on the night of January 4 is more apparent than real, owing to 1900 not being a leap year.

JOHN R. HENRY.

Frost Patterns in Mud.

ON many occasions recently frost patterns in mud have been exceptionally well marked, similar to those formerly described by Prof. Bonney and others (see NATURE, vol. lxiii. p. 347; *Proc.* Roy. Soc, vol. lxiii. p. 217).

On December 15 several of the usual forms were to be seen, the patterns generally being rather coarse, but elaborate, having branched and curving axes.

Thus, (1) on many ordinary flagstones the ice-fronds spread from the centre outwards, over a patch, roughly oval on an oblong stone, roughly circular on a square one, leaving bare a space towards the edge; although sometimes radial or branched forms started from the edge in addition. (2) The centre of the pattern on some flagstones was occupied by a lumpy mass. This consisted of frozen mud, sometimes having a border two to three inches wide formed of scattered separate lumps. (3) One example, however, was rather exceptional. On a concrete path in St. James's Park a space of a few square yards was broken into patches (from a few inches to 2 feet or more in diameter) with outlines roughly hexagonal or partly curved, resembling the ends of basalt columns. In these patches the branching frost-fronds had spread from the centre outwards, while, between the patches, a space about ½ inch broad was clear of ice. This example reminded me of the spheroids with attempts at spherulitic or variolitic structure in various igneous rocks (see *Q.J.G.S.* vol. xlix. p. 155); and here also one asks whether the contraction which caused such jointing was favourable to crystallisation, or did the crystallisation from a centre cause the contraction, or were the two independent though they cooperated to produce the general result?

CATHERINE A. RAISIN.

THE ROYAL COMMISSION ON COAL RESOURCES.

THE announcement that a Royal Commission has been appointed to inquire into the coal resources of the United Kingdom had not been anticipated by public opinion. Yet, in view of the articles on the subject published in NATURE (1897, p. 389, and 1900, p. 124), it should hardly give occasion for surprise. The duration of the British coal supplies is a question that has lost none of its interest since the previous exhaustive inquiry conducted in 1866–1871 by the Royal Commission of which the late Duke of Argyll was chairman. The fifteen Royal Commissioners—all of whom, with one exception, have now passed away—were among the most eminent men of their day, and their calculations were carried out in a thorough and complete manner. In the course of thirty years, however, unexpected changes have taken place in the coal trade. The annual output of coal in the United Kingdom thirty years ago was not more than 100,000,000 tons; it now exceeds 225,000,000 tons, and the process of exhaustion still continues. The beginning of the twentieth century is evidently an opportune time for taking stock of the national resources of the mineral on which so much of the prosperity of the country depends. The new inquiry is to be of a far-reaching character. The terms of reference are as follows:—

To inquire into—(1) The extent and available resources of the coalfields of the United Kingdom; (2) the rate of exhaustion which may be anticipated, having regard to possible economies in use by the substitution of other fuel or the adoption of other kinds of power; (3) the effect of our export of coal on the home supply and the time for which that supply, especially of the more valuable kinds of coal, will probably be available to British consumers, including the Royal Navy, at a cost which would not be detrimental to the general welfare; (4) the possibility of a reduction in that cost by cheaper transport, or by the avoidance of unnecessary waste in working through the adoption of better methods and improved appliances, or through a change in the customary term and provisions of mineral leases; and

(5) whether the mining industry of this country under existing conditions is maintaining its competitive power with the coalfields of other countries.

The chairman of the Commission is the Right Hon. W. L. Jackson, M.P., chairman of the Great Northern Railway Company, and he has fifteen colleagues. Coal-mining interests are represented by Sir W. T. Lewis, the eminent South Wales colliery owner, Sir Lindsay Wood, chairman of the Durham Coal Trade Association, Mr. A. C. Briggs, of Normanton, Yorkshire, Mr. J. S. Dixon, the Scotch coal-master, president of the Institution of Mining Engineers, Mr. A. Sopwith, of Cannock Chase Colliery Company, and Dr. C. Le Neve Foster, F.R.S., professor of mining at the Royal College of Science and Royal School of Mines. The working men's interests are entrusted to Mr. W. Brace, of the South Wales Miners' Federation, and Mr. R. Young, of the Northumberland Miners' Association. Transport interests are in the hands of Sir G. J. Armytage, chairman of the Lancashire and Yorkshire Railway Company, of Mr. Thomas Bell, coal exporter of Newcastle-on-Tyne, and of Mr. J. P. Maclay, shipbroker, of Glasgow. Geology is represented by Mr. J. J. Harris Teall, F.R.S., Director-General of the Geological Survey, by Prof. C. Lapworth, F.R.S., of Birmingham University, and by Dr. E. Hull, F.R.S., formerly Director of the Geological Survey of Ireland, whilst chemistry is represented by Prof. H. B. Dixon. F.R.S., of Owens College, Manchester.

The main interests involved are thus represented with the exception of the consumers. The metallurgical industries, which consume such vast quantities of British coal, do not find their spokesmen on the Commission. This is a matter of regret, inasmuch as metallurgy was so largely represented on the previous Commission ; and the investigations of Sir Hussey Vivian, Dr. Percy, Mr. Hartley of Wolverhampton, and Mr. G. T. Clark of Dowlais, on waste in combustion were amongst the most valuable of the results of the Commission.

The task of the Royal Commission to estimate the available resources of the British coalfields is one of great difficulty, and it is to be feared that any estimate must be of slight value, owing to the impossibility of prophesying with accuracy either the rate of increase in production and consumption, or the limits at which mining may be carried on with profit. Prof. Hull, one of the Commissioners, has already published a reassuring estimate, although it is not in accord with the less optimistic and divergent views expressed by Prof. Stanley Jevons, by Mr. Leonard H. Courtney, by Mr. R. Price-Williams and by Mr. T. Forster Brown. The questions of the possible economies in the use of coal and of the adoption of better methods of working should prove the most fruitful field for the Commission's labours. Great Britain now produces one-third of the world's supply of coal ; and more and more attention is being devoted to improvements in mining details. Although the use of mechanical coal cutters has by no means become as general as it has in the United States, where 25 per cent. of the output is thus obtained, there has recently been a distinct increase in the use of these labour-saving appliances. Moreover, endeavours are being made to economise in the consumption of coal, notably in the South Staffordshire coalfield, where the producer-gas invented by Dr. Ludwig Mond has recently been introduced as a cheap source of heat and power. That great economies in the home consumption of coal have been effected since 1871 is unquestionable. Indeed, Mr. Price-Williams has shown that, whereas in 1871 the iron and steel trade required 30 per cent. of the coal consumed in the United Kingdom, its requirements had been reduced to 16 per cent. at the time he read his paper before the Statistical Society in 1889. To further coal economies effected in the manufacture of iron and steel Mr. Bennett Brough has drawn attention in an article on the scarcity of coal in the *Nineteenth Century* (April, 1900). There is, however, still room for large economies in coal in the manufacturing industries ; and the results of a searching inquiry into the subject cannot fail to be of permanent value and interest.

ON PAPER AND PEROXIDE OF HYDROGEN.

I DESIRE to show by means of the following photographs some special points of interest which occur when certain papers are allowed to produce pictures on a photographic plate in the dark. Some papers are themselves active, that is, if they be simply placed on or near to a photographic plate in the dark they act upon it so that after ordinary development a picture is produced. Other papers which are without this power can be examined by placing them on a photographic plate and putting behind them a plate which is giving off hydrogen peroxide, such as one of plaster of Paris or a pad of blotting-paper which have been soaked in an aqueous solution of this body, or a plate of polished zinc, or a piece of cardboard or glass which has been painted over with copal varnish or other body of that kind. There is also with regard to paper the action of writing and printing ink upon it.

The fibres which are used in paper making are [1] cotton, flax, hemp, wood celluloses, esparto, straw celluloses,

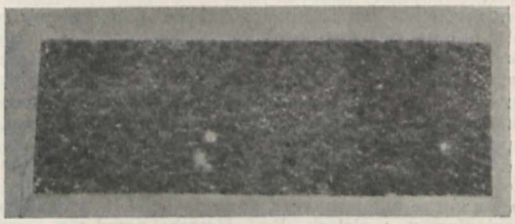

FIG. 1.

mechanical wood pulp. Of these bodies cotton and hemp are entirely without action on a photographic plate ; all the other materials are more or less active, especially so is mechanical wood pulp and flax. If, however, any of these bodies, even the most active, be bleached, they lose this activity ; the bleaching must, however, be very complete to destroy altogether their activity, and many papers although bleached are still active. On the other hand, the activity of a paper may arise, not from the paper itself, but from the size which has been added ; this occurs when rosin is used.

The ordinary first-class papers are entirely without action on a photographic plate, but the common kinds are generally active. For instance, we may take some of the daily newspapers as illustrating this. The following results apply to copies issued on November 25, 1901 : the *Standard*, *Daily Express* and *Daily Mail* all gave a dark picture, the *Pall Mall* a good, but not so dark a picture as the former papers ; the *Westminster* and the *Sportsman* gave a faint picture, and the *Times*, *Globe* and NATURE only very faint pictures, and, lastly, the *Daily Telegraph*, *Daily News*, *Daily Graphic* and *Morning Leader* gave no picture at all. *Punch* paper is also not active.

With books and periodicals the least expensive are usually the most active ; as far as I am aware the paper of high-class books is without action on a photographic plate. Fig. 1 is a picture produced by an active paper.

[1] Report on the Deterioration of Paper, Society of Arts.

This and all the following pictures, when no statement to the contrary is made, have been obtained by an action of the paper on the photographic plate for eighteen hours at a temperature of 55° C. Fig. 2 shows that absolute contact between the active paper and the photographic plate is not necessary, for in this case a thick copper

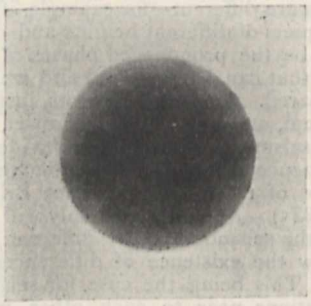

FIG. 2.

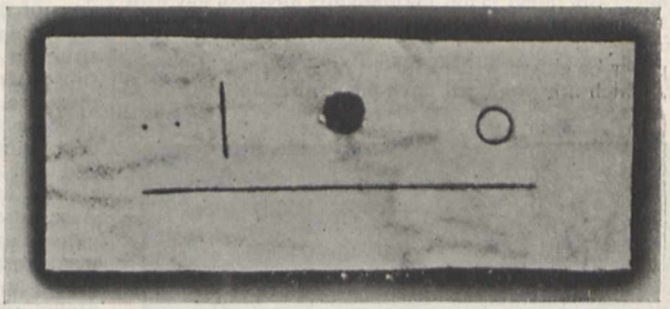

FIG. 3.

screen with a hole in the centre was interposed between the paper and the plate. This action of certain papers is shown in an interesting way with many cardboards. The following experiment, Fig. 3, was made with a photographic mount. A small piece was cut off and on it a long cut was made with a sharp knife passing through the external paper and into the substance of the cardboard. The dark circular patch was where a cork borer had been pressed about half way through the cardboard and the upper part removed. The black ring is a cut made by the same cork borer, but nothing removed. The two dots are two pin holes. Thus it seems as if an active vapour arising from the interior of the cardboard collected in these cavities and acted on the plate. A piece of cork acts in the same way; all the holes give

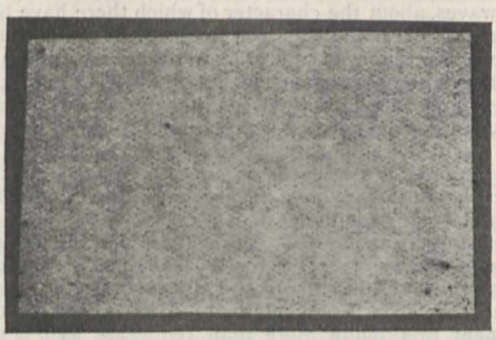

FIG. 4.

black pictures. In this figure the strong action of the recently cut edge is very striking.

Turning now to the case in which the action does not arise from the paper itself, but from hydrogen peroxide purposely placed behind the paper, we can obtain, again, some interesting results. The best way of applying the hydrogen peroxide is by means of a slab of plaster of Paris. This should be cast on a plate of glass and be about a quarter of an inch or slightly more in thickness. After it has been allowed to dry it may be painted over or dipped into a strong or weak solution of the peroxide of hydrogen. The slab is again allowed to dry. It will increase in activity for the first two days and after then gradually decrease, and if a 15 per cent. solution has been used it will be about ten days before it has lost its power of acting on a photographic plate. Other sources of hydrogen peroxide that are convenient to use are a bright zinc plate, or a piece of Bristol board, or a glass plate, that have been painted over with picture copal. Fig. 4 is a picture of the paper of the *Times* produced by placing it on a photographic plate and a charged slab behind it for four minutes. Fig. 5 is the picture of a writing paper 150 years old. The exposure to the hydrogen peroxide in this case was eight minutes, as the paper was thicker and less easily permeated by the peroxide. In the same way it is easy to obtain a good picture of the water-mark on a paper.

This application of the hydrogen peroxide to the back

FIG. 5.

of a paper shows an interesting change which paper undergoes on being wetted. Take a paper which is easily permeated by hydrogen peroxide, wet it thoroughly in water, then hang it up at the ordinary temperature until

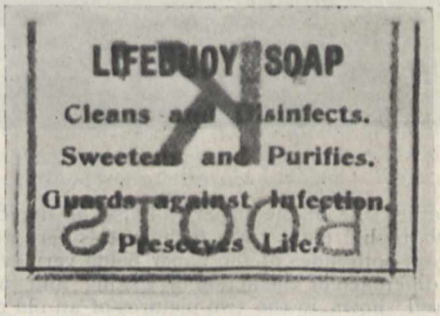

FIG. 6.

perfectly dry, and it will be found to be quite opaque to the hydrogen peroxide given off from a zinc plate or from copal or turpentine. This opacity of the paper, however, gradually passes off, and after two to three days

at an ordinary temperature, or six hours at 100°, it has returned to its transparent state. With Ford blotting-paper the time of recovery is longer. On the other hand, if a paper be made only slightly moist, this facilitates the passage of the peroxide through it. If different substances be dissolved in the water used for wetting the paper it modifies the result obtained. With some substances the paper is not permanently affected, but with others—such, for instance, as alum—the paper remains opaque.

If paper be either written or printed on, the different effects which are produced have been already described.

FIG. 7.

The ordinary writing ink, allowed to dry on paper, renders it perfectly opaque to the action of the peroxide and retains this power for a very long time. The direction of a letter written in 1801 shows the writing with remarkable sharpness. The picture was produced by placing a zinc plate behind the letter. Then with regard to printing ink, it is a body which in itself is active, so that it has only to be brought in contact or in proximity to a photographic plate to give a picture. Naturally the activity of the ink varies much in different cases, and is in most cases capable of giving, not only a picture where the ink is facing the plate, but the printing

FIG. 8.

on the other side of the paper will also be depicted on the photographic plate. Fig. 6 shows this very well, the printing on both sides of the paper being very evident.

This difference of the action of writing and printing ink is well shown in the two pictures of an old cheque, Figs. 7 and 8. No. 7 is simply an ordinary photograph of the cheque, but No. 8 is a picture of the same cheque produced by placing it on a photographic plate with a zinc plate behind it; the printing-ink has become inactive, but the writing ink is still able to prevent the hydrogen peroxide from passing through.

W. J. RUSSELL.

WHAT ARE SEISMOMETERS INDICATING?

ONE thing which a modern seismometer does, and does in a satisfactory manner, is to indicate the time of arrival of the various phases of motion which constitute an earthquake. With two similar instruments at the same station, the time of commencement of a given earthquake is practically identical; but if the installations of the instruments are different—for example, if the instruments rest upon piers of different heights and construction—it will only be the pronounced phases of the subsequent movements that can be identified and which, therefore, can be compared. If our instruments, instead of being in the same room, are 100 to 800 feet apart, the only points in the two seismograms which can be identified will be the commencements and the pronounced shocks, which latter are of rare occurrence (see British Association Reports, 1885). As a rule not only will the general appearance of the seismograms be different, but measurements will show the existence of differences in period and amplitude. This being the case for seismograms obtained at stations near to each other, what coincidences can we possibly hope for in seismograms obtained at stations located at a few, several hundreds or several thousands of miles from each other?

Next, if we turn to a consideration of the character of the earth movements which produce seismograms relating to earthquakes the origins of which are at a great distance, we meet with observations the explanation of which is not simple. The first rapidly recurring tremors that a seismograph records are regarded as elastic waves of compression and rarefaction. One reason for this belief is that the observed velocities with which these precursors traverse either the surface materials or the body of the earth are such as would be expected for this particular form of wave in the media considered.

Following these forerunners by an interval of time which increases with the distance of the observing station from the earthquake origin are a series of more pronounced movements, usually referred to as shocks or large waves, about the character of which there have been differences of opinion. For earthquakes originating within a few hundred miles of an observing station we find that the records of such waves obtained from bracket seismographs are described as horizontal movements, whilst those from spring-lever seismographs are referred to as vertical components of motion. So long as the latter records are not shown upon a seismogram the former have always been regarded as described, their apparent magnitude being dependent on the multiplication of the writing indices. When, however, in a register we see entries for "vertical motion," neither the measurements for this nor for the corresponding entry for horizontal displacement can be relied upon. The reason for this statement, first made more than ten years ago, is that with severe earthquakes for 100 or more miles round the epicentre we have a vast amount of evidence showing that the ground is thrown into a series of surface-waves. These angular displacements cause horizontal pendulums to swing from side to side, whilst the levers of lever seismographs move up and down, the result being that both types of instruments, instead of measuring components of motion relatively to steady points, act as indifferent clinographs. In consequence of these considerations, at the end of 1891 I designed a clinometer for earthquakes. Briefly, this consisted of a balance-beam loaded at its two extremities, which when its frame was tilted in a direction at right angles to its length was assumed to retain its horizontality. A pointer like that of an ordinary balance attached to this beam acted as a steady fulcrum for the short arm of a light lever, the outer end of which rested on a smoked glass surface. An example of the seismograms giving the period and slope of earthquake-waves obtained by this apparatus will be found in the British Association Reports, 1893.

Inasmuch as these surface-waves could be recognised at a distance of a few hundred miles from their origin, it was naturally assumed that the movements resulting from unusually large disturbances which not unfrequently travel to their antipodes should exhibit the same undulating characteristics. Some support to this view was found in the large movements of delicately adjusted horizontal pendulums, the movements recorded in the traces from magnetographs and barographs, whilst the movements occasionally noted of the bubbles in astronomical levels or the shifting of a star in a telescopic field, together with other phenomena, tended to strengthen the view that the large waves in seismograms represented actual earth tilting. Although I do not yet see how certain of these phenomena can be explained on the assumption of purely horizontal movements, especially when the period of these may exceed twenty seconds, in a British Association Report (September 1900) I published observations indicating that the surface-wave theory met with so many objections that it could not be generally applied. One objection rested upon observations indicating that the velocity of propagation of these waves did not appear to be constant.

Although for certain practical purposes it may be assumed that the arcual velocity of these movements is 3 km. per second, there is evidence to show that they have an initial velocity of about 2 km., whilst their quadrantal velocity approaches 4 km. per second. Dr. C. G. Knott, who has done so much for practical and theoretical seismology, at once pointed out that any change in speed was a serious stumbling-block to the surface-wave theory, which he had always regarded with disfavour. As an alternative, in the *Scottish Geographical Magazine* (January 1899), and in other publications, he showed that the observations relating to speed could be satisfied by the assumption of a distortional mass wave, and it is to the outcrop of such waves to which Dr. Knott looked for the explanation of the large movements of the seismograph.

This hypothesis, however, does not tell us whether the movements actuating a seismograph are vertical, horizontal or angular. Many years ago Dr. A. Cancani pointed out that if these waves represent tilting, from the angular values of the same and the length of the waves which can be deduced from their period and velocity, then on the assumption of simple harmonic motion the height of such waves could be calculated.

Such heights have been frequently estimated, but in the British Association Report (September 1900), p. 83, attention is called to the fact that as these represent accelerations not unfrequently 1/50 of gravity, the existence of these vertical displacements is doubtful, and an experiment to confirm or modify our views was in progress.

The "experiment" referred to consisted in observing the movements of a pointer attached to the earth relatively to the pointer of a clinograph similar to, but much larger than, the one described above. Any relative movement of these pointers would be shown by the displacement of a spot of light reflected from a mirror hung by a bifilar attachment to the two pointers. Subsequently the record was made mechanical. With the first installation 1 mm. deflection = 0″·7, and in the second 6″·0. Although several large earthquakes occurred, no record was obtained.

In another experiment slight records were obtained from the photographic registration of a spot of light reflected from a mirror which was caused to rotate by the rising or falling of a weight attached to an ordinary spiral spring. The length of the spring under the influence of its own weight is 9·5 inches. With a load of 1 lb. 8 ozs. its length was 3 feet 5 inches and its natural period 2 seconds.

The earthquake of October 9, 1900, caused ripples on the photogram each about ·5 mm. in range, which would correspond to a change that might have been produced by increasing and decreasing the load by 1/700 part of itself. The period of motion was approximately 6·5 minutes, which corresponded with the period of maxima in the large waves as in an ordinary seismogram.

The Venezuela earthquake of October 29 gave deflections of half the above and with periods of about 7 minutes. Other earthquakes caused somewhat similar movements, but usually nothing more than slight blurs upon the photographic traces were to be seen.

The records from the clinometer indicate that earth tilting has not been measurable by the instrument employed, whilst the records from the spiral spring show that there is a possibility that vertical motion may exist, but if it does it is exceedingly minute.

The general inference is that the large waves due to earthquakes originating at a distance, whether they are surface waves or mass waves, actuate horizontal pendulums by horizontal displacements of the ground, rather than by the tilting of the same.

The distinguished seismologist, Dr. F. Ōmori (see "Publications of the Earthquake Investigation Committee," Tokyo, No. 5, January, 1901), and Dr. Wilhelm Schlütter (see his "Inaugural Dissertation," Göttingen, 1901) have recently expressed similar views. Dr. Omori's objection to the surface-wave theory is based partly upon the impossibility of accepting the vertical accelerations calculated on the assumption that seismographs have acted as clinometers, a view already expressed by Dr. C. G. Knott, Dr. C. Davidson, myself and other physicists, and partly upon the observations he has made showing that the amplitude of seismograms depends upon the multiplication of the writing pointers rather than the sensibilities of seismographs to tilting.

Dr. Schlütter's conclusions are arrived at from the fact that some twenty earthquakes failed to yield any record on the photograms obtained from a "klinograph," which in general arrangement is not unlike those already referred to, but very much more sensitive. The care which Dr. Schlütter took to ensure accuracy can only be realised by reference to his memoir, which, as an essay relating to this class of investigation, stands *facile princeps*.

The general conclusions arrived at are that for severe earthquakes with a near origin, surface earth-waves may be marked. To record these clinographs are required, and the entries in registers referring to the same should be correspondingly modified. In designing instruments to record earthquakes with a distant origin, the principle introduced by Prof. J. A. Ewing into seismometry relating to steady points must be carefully observed, and in our registers we must regard our entries as referring to displacements which are horizontal rather than angular.

J. MILNE.

ELEMENTARY MEDICAL EDUCATION.

WE have received a memorial to the General Medical Council concerning the relegation of the teaching of elementary chemistry, physics and biology to the school, as distinguished from the medical school. The memorial is signed by a number of men of science, teachers of botany, zoology, chemistry or physics. In the opinion of these gentlemen the above subjects should be permanently retained as part of the medical curriculum proper, and their relegation to the schools is, according to them, likely to have a prejudicial influence upon medical education. The most powerful argument, so far as we can see, brought forward in support of this hypothesis is that the schoolboy, as distinguished from the medical student, is intellectually less capable of grasping those scientific generalisations without which the teaching of the elementary scientific subjects above named would not be productive of the desired result, viz. the

development of a truly scientific mind. This as a general statement may perhaps be admitted, though it must be at once pointed out that the difference between the intellectuality of a schoolboy aged sixteen and of a medical student aged seventeen *qua* age is not great, if it exists at all, and postponement of the teaching in these subjects beyond seventeen or eighteen would certainly be impossible.

All are agreed that the attainment of scientific methods of observation and reasoning is a quality of the first importance to the future medical man, especially as the ultimate result of his education, viz. the practice of medicine or surgery, is essentially an inexact science, one in which the data for the formulation of conclusions are extraordinarily inconstant and ephemeral, often demanding for their detection the most trained observation, and for their elucidation the most careful reasoning.

The medical curiculum is, however, filled to the bursting, and unless we want the student to emerge from it partially insane, some depletion must take place. It should also be remembered in this connection that intellectual attainments are not the sole requirements of the medical man. Manipulative skill, and, further, physical training, rendering him capable of enduring physical strain, are also practically essential. This and the fact that the actual subject-matter of medicine and surgery has increased enormously during the last few years, not merely in the direction of biology, chemistry and physics, but also in that of the actual accumulation of clinical fact, render the intellectual burden to be laid, according to the present arrangements, upon the medical student more than he can bear.

Further, the student of medicine stands in a peculiar position with regard to chemistry, biology and physics, for while it is not to be denied that a clear understanding of them is necessary to his education, yet nevertheless it is not only from them that he receives training in the methods of pure science. After having mastered the essential principles of these he still spends two years or more in the study of science, preparatory to entering upon the subject-matter proper of his profession. The first, second, and often third year are devoted to physiology, anatomy and pharmacology ; all subjects which tend, not only to store the mind with fact, but also to educate it in scientific method. If the training of the medical student in scientific method depended solely upon the teaching in chemistry, physics and biology, referred to in the memorial we have received, we confess that we should view with concern the relegation of these subjects to the schools ; clearly, however, this is not the case, and since something must be done to relieve the overwhelming mass of knowledge to be acquired by the average student in five short years, we feel that the General Medical Council are acting wisely in demanding more of the schools. It is, however, to be hoped that it will see that the school teaching in these subjects is efficient and that the student comes up to the medical school thoroughly grounded in them.

F. W. T.

SUMMARY OF PROGRESS OF THE GEOLOGICAL SURVEY.

THE publication of the Summary of Progress of our British Geological Survey for the year 1900 has evidently been delayed, for we have long ago received and noticed the annual reports of the Canadian and Indian Geological Surveys, and we have likewise referred to the retirement of Sir Archibald Geikie, who in this publication issues his last official report on the work which for so many years he directed. It is a report which, as usual, provides material of sufficient diversity to interest students of all branches of geology. Those who cultivate a knowledge of the oldest rocks will find ample material for consideration in the accounts of the Moine schists and Muscovite-biotite gneiss of Ross-shire, and in the fuller descriptions of the Dalradian or younger schists of the central Scottish Highlands. Thrust-planes and the phenomena of thermo-metamorphism and contact-metamorphism are dealt with, as well as the relations of the schists to the older and newer granites and other igneous rocks. Outside the great granite masses of Lochnagar and the Cairngorm Mountains there is an exceptional extension of cordierite-hornfels, due to the alteration of aluminous black schist ; while impure limestones are characterised by the development of silicates, of garnet, idocrase, malacolite and wollastonite. Special attention is drawn to the distinction which it is sought to make between the band of schists known to the surveyors as the "Green beds," originally sedimentary rocks, and the Epidiorites, which occur as sills of much-foliated igneous rock. The "Boulder bed" also forms an important horizon in the mass of Dalradian schists. In some places it affords evidence of having been in part a true conglomerate before any movement such as shearing or crushing took place ; elsewhere it appears as a crush conglomerate, or it presents an "augen-structure" on a gigantic scale. In Ireland attention was mainly given to the Silurian rocks of Waterford and Wexford and their associated intrusive and volcanic rocks, which are described in some detail. In the south-west of England work was carried on among the Lower Devonian rocks of Looe in Cornwall and on the various subdivisions of the "Killas" near Falmouth, the "greenstones," and the granite of Penryn.

In the great South Wales coal-field work has been vigorously prosecuted in the district around Swansea. There the Old Red Sandstone and the Lower Carboniferous rocks are of especial interest in connection with their Devonshire equivalents, and it is of the highest interest to learn that radiolarian chert has been recognised in the Gower series described long ago by De la Beche and compared by him with the Coddon Hill beds of North Devon.

The Gower series occurs on top of the main mass of Carboniferous Limestone and belongs to the group of "Upper Limestone shales." These are represented on the north crop of the South Wales coal-basin by "Rottenstone shales," in which also bands of radiolarian chert have been discovered. The upper part of the Gower series consists of a mass of dark shales in which *Goniatites* (*Glyphioceras*) *bilinguis* and *Posidonomya* have been found. At a higher horizon come the hard sandstones and conglomerates of the Millstone Grit. The discovery of these radiolarian cherts is thus an important link in the correlation of the strata in Devonshire and South Wales, for it had been held that the Coddon Hill chert beds might represent the mass of the Carboniferous Limestone. As the work of the Survey proceeds westward further interesting results may be anticipated, especially with regard to comparisons between some of the underlying Lower Carboniferous strata and the Upper Devonian. The Old Red Sandstone has been studied as far north as Caithness, where some of the flags and shales are so bituminous as to become impure oil-shales, while albertite or mineral pitch is found distilled out into the faults and cracks of the strata over large areas. In Argyllshire the relation has been worked out between some of the younger granites of Ben Cruachan, Blackmount and the Moor of Rannoch, and the vents of the Lorne volcanic region. As these vents belong to the time of the Lower Old Red Sandstone, the granites which invade them probably belong to the remarkable series of granite extrusions which in the British Islands intervened between the close of the Upper Silurian and the beginning of the Upper Old Red Sandstone periods.

Details are given of the various coal-seams and of

faults and disturbances observed in the coal-field near Swansea; and important suggestions are made regarding the subdivisions recognised in the Upper Coal-measures of North Staffordshire and their extent westwards across the Cheshire plain, and south-westwards into the Birmingham area.

The discovery of Rhætic, Liassic and Cretaceous fossils in rocks, preserved within an old volcanic vent in the Isle of Arran, is of especial interest as indicating the former extent of these Secondary strata. The Cretaceous rocks of the south of England have received attention, more especially as regards the Lower Greensand of parts of Sussex and the Isle of Wight, the subdivisions in which are compared.

Students of Tertiary strata will find interesting references to the successive overlaps of the London Clay and Bagshot beds on the western side of the Hampshire Basin. The volcanic series of Arran and of Skye come into notice also in the portions of the Summary which deal with Tertiary times.

In various parts of the country observations have been made on Pleistocene deposits, the most important being the full account of the glacial phenomena in the Macclesfield district.

The petrographical work includes a particular account of the marbles of Assynt, which have resulted from contact metamorphism produced by igneous rocks on surrounding dolomites. The palæontological work includes important catalogues of type-specimens of Pleistocene, Pliocene and Devonian fossils preserved in the Museum of Practical Geology; and there are special notes on Carboniferous plants from Berwickshire and on the fossil fishes from the Silurian rocks of the Lesmahagow district. In this brief abstract of some of the results of a year's work on the Geological Survey we have refrained from mentioning individuals, but the work of each has been carefully indicated in the memoir. It is satisfactory, moreover, to note the assistance that has been rendered by Mr. R. Kidston, Dr. R. H. Traquair and Dr. G. J. Hinde in the identification of particular groups of organic remains.

SIR J. HENRY GILBERT, LL.D., F.R.S.

THE names of Lawes and Gilbert have been "household words" in the mouths of English students of agriculture during the past half century. Sir John Lawes departed from amongst us last year, at the age of eighty-five. His colleague, Sir J. H. Gilbert, has also now finished his labours; he died at Harpenden on December 23, at the age of eighty-four.

Joseph Henry Gilbert was the second son of the Rev. Joseph Gilbert, a nonconformist minister at Hull. He was born at Hull in 1817. His mother, Ann Gilbert, was a daughter of the Rev. Isaac Taylor, of Ongar, and thus belonged to a well-known literary family; she was herself the authoress of numerous poems for children. While at school young Gilbert met with a serious accident, and practically lost the sight of one eye. His great pluck enabled him to accomplish his life's work with little apparent hindrance, but the disadvantage of weak sight was very real, and much of his subsequent literary work had to be dictated. He went from school to Glasgow University and studied chemistry under Dr. Thomas Thomson. From thence he went to University College, London, and commenced working in the laboratory of Dr. Antony Todd Thomson. Here apparently he first made the acquaintance of Mr. John Lawes, who was a frequent visitor to the laboratory. He next proceeded to Giessen, where Liebig was then professor of chemistry, and took the degree of Ph.D. in 1840. Dr. Gilbert then acted for a short time as assistant to Dr. Antony Todd Thomson, and afterwards left to take up calico printing and dyeing in the neighbourhood of Manchester.

It was in 1843 that Dr. Gilbert's services were engaged by Mr. Lawes for the agricultural investigations then commencing at Rothamsted. We have already noted in these pages (NATURE, September 13, 1900, p. 467) the foundation of the Rothamsted agricultural investigations by Mr. J. B. Lawes, their rapid development at his sole expense, and their subsequent liberal endowment by him; we have now to mention the important part taken in the work by his collaborator, Dr. Gilbert.

The two investigators were, to a considerable extent, well matched, each supplying some deficiency in the other. Sir John Lawes brought to the work a very original mind, an enterprising spirit, and a thorough knowledge of the facts of practical agriculture; and this practical knowledge served to inform his judgment and enabled him to test the truth of many of the scientific theories which came before him. Sir J. H. Gilbert, on whom the details of the work devolved, brought to his task a more exact knowledge of science and of methods of investigation, an acquaintance with foreign chemists and foreign literature, and, above all, methodical habits of work, which proved of immense value in planning and carrying on through fifty-eight years the field experiments which became such a striking feature in the Rothamsted investigations. He was an indefatigable worker, and loved to accumulate an immense mass of results, frequently of a similar kind; and a reader of Rothamsted papers is sometimes so overwhelmed by numerical statements that, to use a familiar simile, "he finds it difficult to see the wood for the trees."

The Rothamsted investigators soon found themselves engaged in controversy with German men of science, and Sir J. H. Gilbert at once proved himself to be a warm and untiring antagonist. The first subject of dispute was the so-called "mineral theory" of Baron Liebig. Liebig held that the atmosphere supplied in sufficient quantity both the carbon and nitrogen required by crops, and that the proper function of manure was to supply the ash constituents of the crop it was intended to grow. On the other hand, the Rothamsted field experiments with wheat and barley proved unmistakably that ammonium salts and other nitrogenous manures had a far greater effect in increasing the produce than any application of phosphates, potassium salts, or other ash constituents. So long as the question was confined to the cereal crops, Rothamsted was triumphant; but when leguminous crops became the subject of experiment the answer was doubtful, and in many cases the manures supplying ash constituents proved the most effective. It has taken many years, and tasked many investigators, to elucidate this part of the subject. We now know that the roots of leguminous plants become the habitation of certain bacteria, and that by means of these the plants are fed in a special manner with nitrogen from the atmosphere.

The subject of the assimilation of nitrogen by plants led to one of the most highly prized of the Rothamsted investigations, in which plants were grown from seed in soils destitute of nitrogen, but supplied with ash constituents, and in an atmosphere free from ammonia, the object being to ascertain in a rigorous manner if an assimilation of the free nitrogen of the air took place. The work lasted three years, and was made the subject of a communication to the Royal Society by Lawes, Gilbert and Pugh. The chief honour of the work belongs, in this case, to the last-named author. Pugh was an American studying in Germany, and when the controversy on nitrogen assimilation between Boussingault and Ville was at its height he offered to come to Rothamsted and help to solve the question. His offer was accepted. The whole of the experimental work was conducted by Pugh with an ingenuity and accuracy which were justly admired.

In later years another controversy arose as to the part taken by carbohydrates in the formation of animal fat. Lawes and Gilbert had satisfied themselves by their experiments on pigs that fat was undoubtedly produced from carbohydrates. The German physiologists doubted this, and at one time Rothamsted and its followers stood almost alone in their opinion. Now the tide has turned; the experimental evidence for the formation of fat from carbohydrates has become overwhelming, and it is even believed by some that no fat is formed from the albuminoids of the food, but that all the fat stored up by the animal is derived either from carbohydrates or from the fat originally present in the food. The question is one of very great practical importance, the German school formerly insisting that nitrogenous foods must be selected for economic fattening, while the English teaching gave the farmer a much wider choice.

The scope, development and results of the Rothamsted experiments, and the numerous honours jointly conferred on Lawes and Gilbert, have been so recently noticed when speaking of the work accomplished by Sir John Lawes that a repetition of them here seems hardly necessary. Sir J. H. Gilbert was at his death the oldest surviving Fellow of the Chemical Society, having been elected in 1841. He became president of the Society in 1882–3. He was elected a Fellow of the Royal Society in 1860, he served on the Council, and was a regular attendant at the meetings of the Society. With Sir John Lawes he received a Royal medal in 1867. He became a Fellow of the Linnean Society in 1875. He was president of the Chemical Section of the British Association in 1880. He was elected professor of rural economy at Oxford in 1884 and held the office till 1890; the subjects chosen for his lectures were the results of the Rothamsted investigations. He received honorary degrees from several Universities, and was a member of various foreign academies and societies. On the occasion of the jubilee of the Rothamsted experiments in 1893 he was presented with a piece of plate, and afterwards received the honour of knighthood.

Sir J. H. Gilbert carefully maintained through life a connection with foreign workers. His holidays were frequently occupied by visits to scientific meetings and institutions in Germany and France. He made three visits to the United States and Canada, and delivered several lectures there. He enjoyed a very vigorous constitution, and continued actively at work up to the last year of his life. Unfortunately, his disposition forbade his co-operation with any younger colleague, and the institution at Rothamsted is now left without any apparent successor to its historic labours.

The funeral of Sir J. H. Gilbert took place at Harpenden on December 27; deputations from various scientific bodies attended. The Lawes Agricultural Trust was represented by Sir Chas. B. Lawes, Sir John Evans, F.R.S., Mr. W. Carruthers, F.R.S., Prof. H. E. Armstrong, F.R.S., Dr. J. A. Voelcker and Mr. H. Rix; the Board of Agriculture by Mr. T. H. Elliot; the Royal Society by Mr. A. B. Kempe, F.R.S.; the Chemical Society by Prof. W. A. Tilden, F.R.S., and Prof. W. R. Dunstan, F.R.S.; the Linnean Society by Prof. G. B. Howes, F.R.S.; the Meteorological Society by Mr. F. C. Bayard; the Society of Chemical Industry by Mr. A. Smetham.

NOTES.

PROF. W. A. HERDMAN, F.R.S., sailed for Ceylon on December 26, 1901, to undertake for the Government an investigation of the pearl oyster fisheries of the Gulf of Manaar. He is accompanied by a first-rate assistant, and in Ceylon the inspector of the fisheries and his staff will cooperate and provide boats and divers. A suitable steamer for dredging and trawling will be placed at Prof. Herdman's disposal by the Government of Ceylon; and the necessary gear and apparatus for collecting and observational work, and for biological experiments, have been sent out in advance. We understand that Prof. Herdman has arranged to take samples of the plankton throughout the voyage to Ceylon, and to launch current-floats at particular parts of the course.

A PUBLIC meeting was held on Friday last at Cromarty, the birthplace of Hugh Miller, for the purpose of discussing what steps should be taken to celebrate next year the centenary of his birth. Sir Archibald Geikie wrote stating that he heartily sympathised with the object of the meeting and wished all success to the movement which it would initiate. After discussion, a committee was appointed to further a scheme for the erection in Cromarty of a Miller Institute, comprising a library and museum.

IT is proposed to commemorate, on June 15 next, the two hundredth anniversary of the death of G. E. Rumphius, the celebrated naturalist who spent his life in investigation at Amboina, one of the Molucca Islands. The authorities of the Colonial Museum at Haarlem have made arrangements for the preparation of a Rumphius medal, copies of which can be obtained in silver or bronze. Subscribers for the commemorative medals who send their names to the president or secretary of the Haarlem Museum before March 1 will receive a copy of a memorial volume to be published in honour of Rumphius.

THE death is announced of Mr. H. G. Madan, senior Fellow of Queen's College, Oxford, and for twenty years head of the science department at Eton College.

WE learn from *Science* that Mr. Alexander Agassiz, accompanied by Mr. W. McM. Woodworth, has undertaken an expedition to the Maldive Islands in the Indian Ocean, in order to study the coral formations. A steamboat for this purpose has been chartered at Ceylon.

DR. SVEN HEDIN, the Swedish explorer, who recently arrived at Ladakh from Central Asia, has sent a telegram to King Oscar announcing that he has made an extremely important journey through all Tibet, disguised as a pilgrim, with two followers. On approaching Lhasa they were recognised and captured, but were well treated by order of the Dalai Lama. A second attempt was opposed by 500 Tibetan soldiers. Dr. Hedin's collections were lost, with almost the whole caravan, but his notes were saved.

THE Board of Agriculture has appointed a committee to investigate the two diseases of sheep known as "braxy" and "louping-ill." The members of the committee are Prof. Hamilton, of Aberdeen University, Mr. J. McI. McCall, assistant veterinary officer to the Board, Mr. E. J. Wheler, agent to the Duke of Northumberland, with Mr. R. B. Greig, lecturer on agriculture, &c., to the Durham College of Science at Newcastle-on-Tyne, as secretary and demonstrator. The mortality from the diseases in question is a cause of very great loss to the sheep-farming industry in Scotland, probably amounting to between a quarter and half a million of money annually, or even more.

DR. HANS REUSCH, Director of the Geological Survey of Norway, directs attention, in a recent issue of *Naturen*, to the fact that the rock at Moskogaissa mine, 750 m. above the sea, in Lyngen, Arctic Norway, is covered with a frozen moraine from 18 to 20 metres thick. On a previous occasion Dr.

Reusch found permanent ice in a bog near Vadsö. At lower altitudes, where the soil lets the water through, no permanent ice occurs. Still, at Karasjok the ground is not far from a state of permanent freezing. The mean temperature of the place is −2·6° C. As it is difficult to dig graves in the ground during winter time, a large hole is made in the autumn and bodies are put into it as people die. The bodies soon freeze hard and sometimes they do not thaw in the spring, when they are buried. It has been found that bodies have remained frozen so long as ten years after their burial.

To the December number of *The Zoologist* Mr. G. Renshaw contributes an interesting article on the extinct blaauwbok (*Hippotragus leucophoeus*) of South Africa. This handsome species, an ally of the sable antelope and the roan antelope, was, it appears, always scarce and local, one of its refuges being the mountains between Swellendam and Algoa Bay, where the last specimens were shot in 1800. Its colour was bluish-grey, with pure white under-parts. The author records sixteen specimens known to have been preserved, but only a few of these appear to be still extant. One skin is now in the museum at Vienna, a second in Stockholm, a third in Upsala, a fourth in Paris and a fifth in Leyden. Our own Natural History Museum possesses a couple of frontlets with horns believed to belong to the blaauwbok. In the same journal Mr. H. E. Howard comments on the marked increase in the numbers of the starling and the hawfinch which has taken place of late years in this country. Writing from Hampshire, he observes of the latter species:—"Fifteen years ago I rarely saw this bird; five years ago small parties of five and six were not at all uncommon; and during the winter now I frequently see as many as a dozen under one yew. This year eight pairs nested within half a mile of my house."

A FEW details concerning the plans of the Scottish Antarctic Expedition are given in the *Dundee Advertiser* of December 25, 1901. The expedition will be directed by Mr. W. S. Bruce, who has had some experience in the Antarctic, and has been engaged in scientific work within the Arctic circle on several occasions. Scientific research will be the chief object of the expedition, and Mr. Bruce will be accompanied by at least seven men of scientific training, who will be engaged with different subjects of investigation. The ship which has been secured for the expedition is a Norwegian whaler called the *Hecla*, a wooden ship of similar dimensions and build to some of the Dundee whalers. The ship will be ready about the beginning of August next and will go for a trial spin for three weeks in the Atlantic for the purpose of testing her gear and instruments before her final departure for the Antarctic, when she will make for the Falkland Islands for the purpose of taking on coal and provisions, and then strike for the field of operations in the Weddell Sea—a region of the Antarctic about which nothing is known, and which has only once been visited by an exploring party, some eighty years ago. This region promises to yield results of very great scientific value, and a thorough knowledge of it would go a long way to solve many of the problems connected with the Antarctic. The Weddell Sea is situated directly between the sphere of operations of the German expedition on the one hand, and the Swedish expedition on the other; so that the results of all three expeditions will be of advantage to each other on their return home. Details of cooperation or division of labour were carefully planned and arranged between the respective leaders of the Scottish, German and Swedish expeditions before the departure of the two latter. It is expected that the expedition will be absent more than a year at least, and possibly much longer if the necessary funds are forthcoming. The whole of the money subscribed towards the expedition has been given by Scotsmen only, and as the scientific staff and ship's officers and crew will also belong to the northern side of the Border, the whole project is a truly Scottish one.

M. C. GUTTON has described in the *Journal de Physique* for December some experiments tending to show that the wave-length of Hertzian oscillations is the same in water as in air. The corresponding property for castor oil has been previously proved by M. Blondlot; the present result is interesting, as in the case of water the imperfect conductivity gives rise to absorption of the oscillations.

A NEW method of determining the principal indices of refraction of a crystal by means of the critical angle has been investigated by M. Cornu, and the results are briefly detailed in the *Bulletin* of the French Physical Society, 172. The method is based on M. Cornu's geometric investigations of the total reflection at the surface of a crystal, and has been applied to calculate the indices of refraction in tartaric acid. In this substance the angle of conical refraction amounts to 4°, and interesting lantern experiments are described on the conical refraction of a crystal 23 mm. thick as well as on ordinary crystals of commercial tartaric acid immersed in clove oil.

THE design and construction of fly-wheels for slow-speed engines for electric lighting and traction purposes are discussed by Mr. A. Marshall Downie in the *Transactions* of the Scotch Institution of Engineers and Shipbuilders, xlv. 1. By projecting the indicator diagrams of the several cylinders of compound engines the author obtains curves representing the fluctuations in the combined crank efforts at different points of the revolution. From an examination of these fluctuations the author arrives at the conclusion that a good average value for the energy necessary to be stored in fly-wheels for electric lighting purposes is 2·9 foot-tons per electric horse-power, and in traction-plant 4 foot-tons.

FROM observations described by Prof Geitel in the *Physikalische Zeitschrift*, iii. 4, it appears that atmospheric air is itself capable of inducing radio-activity. When a mass of air remains shut up for a long time in a cellar or cave, Prof. Geitel finds that its electric conductivity increases to a maximum. There are three hypotheses possible, namely, that the exposed substances were themselves radio-active, that traces of radio-active substances were present in the neighbourhood, or that the air itself is the origin of the radio-activity. From experiments made with a kite at a considerable height above the ground and from other evidence, Prof. Geitel favours the view that the third is the most likely hypothesis.

DR. FOVEAU DE COURMELLES and M. G. Trouvé describe, in the *Bulletin* of the French Physical Society, certain new apparatus for the study of different light-rays of considerable intensity. These are based chiefly on the use of parabolic reflectors and other concentrators, and screens for filtering out the heat-waves or separating those of any required portion of the spectrum. The authors have applied their apparatus to the cure of lupus, tuberculosis, and other diseases at the Hospital of St. Louis in Paris, without producing any burning or blisters, the source of energy being an arc lamp of 10 amperes radiating for 10 minutes at 70 watts, or 8 amperes at 85 watts, while with Finsen's apparatus 75 to 80 amperes for 80 minutes are necessary.

THE arrangements for photochronographic observations in the physiological laboratory of Moscow University form the subject of a paper by Prof. L. Morokhowetz and Drs. A. Samojloff and A. Judin, published by the Imperial University Press. The room used for these observations is divided into four parts, one of which is described as a "monster camera," being a dark room in which the photographs can be exposed and watched during

the exposure. Among the apparatus used is a pendulum photo-chronograph, in which the pendulum carries a sensitive plate and is provided with a contrivance for releasing it at will and fixing it at the end of each half-oscillation. The papers are illustrated by photographs of the curves of different vowel sounds, taken in the laboratory.

THE problem of the perfectly irresistible body impinging on a perfectly impenetrable obstacle is scarcely more paradoxical than Poinsot's problem of a rigid body having two points fixed, when it is proposed to calculate the actual reactions and not merely the sum of the reactions along the line joining the points. The *Bulletin* of the Belgian Academy contains reports on a paper by M. Ferron, in which that author endeavours to overcome the indeterminateness of the problem by replacing the force Z at any point in the body by its components in the lines joining its point of application to the two fixed points. One of the referees of the paper, M. Ch. Lagrange, objects to the principle of transmission of force being applied in this case, but he does not hesitate to apply it in a paper of his own, in which he seeks to prove that each of the reactions is equal to $\frac{1}{2}$ Z.

A THEORY of progressive taxation, capable of being represented by simple mathematical formulæ, is discussed by Mr. G. Cassel in the *Economic Journal* for December. It is pointed out that the same results that are obtained by means of a graduated income-tax can equally well or better be effected by levying a tax at a constant rate per cent. and allowing suitable deductions to be exempted from taxation. Moreover, if a tax is to produce "equal sacrifices" the amount which should be exempted from taxation should be larger for large than for small incomes, as the cost of living consistent with efficiency increases with the amount of income to be earned. Mr. Cassel's proposal is based on the supposition of a "minimum of subsistence" representing the income exempt from taxation, and a "maximum of subsistence" representing the cost of living consistent with efficiency in earning an infinite income. The amount deducted for subsistence and the rate of taxation are then represented by formulæ of the form known to mathematicians as "homographic transformations."

IN the use of the wet and dry bulb thermometer for determining the pressure of aqueous vapour in air, considerable uncertainty is introduced by the presence of a constant which varies according to the conditions under which the thermometers are placed. The extremes are represented by August's formula, which supposes the air round the bulbs to be constantly changing, and Maxwell and Stefan's result, which is calculated on the hypothesis that the water on the bulb is evaporating and its vapour diffusing into an infinite mass of quiescent air. Signor G. Guglielmo, writing in the *Atti dei Lincei*, x. 9, now proposes to eliminate the arbitrary constant by the use of a *third* thermometer, the bulb of which is wetted by an aqueous solution the vapour tension of which differs considerably from that of pure water. In this way a further equation is obtained and the unknown constant is eliminated. Some preliminary experiments are quoted showing the efficacy of the method. The difficulties of applying it arise from the change in concentration of the solution caused by evaporation, and the consequent uncertainty as to its latent heat. But could not a second volatile liquid be substituted for the saline solution?

AT a recent meeting of the Meteorological Society of Mauritius, the secretary, Mr. T. F. Claxton, read an interesting paper on the objects for which that Society was established, in the year 1851. These were, chiefly:—To provide for regular observations in Mauritius and its Dependencies (Rodrigues, Seychelles, Diego Garcia, &c.), the establishment of a permanent observatory, and the collection and tabulation of observations taken in the Indian Ocean. Some of these objects have been successfully carried out, as shown by the *Transactions* of the Society and the annual reports of the Royal Alfred Observatory. The establishment of this observatory (in 1874) was perhaps the most important achievement of the Society; it is supported entirely from Government funds, and the director has always been the secretary of the Society. Every ship visiting the island is boarded and permission requested to extract observations for the construction of charts. Cyclone tracks of the Indian Ocean were published in 1891 and are of great use to navigators at the present time, and an important work has recently been commenced, viz. the tabulation into 5° squares of all the information collected from the log-books of vessels that have traversed the Indian Ocean since 1854, with the view of constructing a meteorological atlas of the south Indian Ocean; this will doubtless be of much practical use to sailors. Unfortunately, there has been a steady decrease in the number of vessels trading with Mauritius, from 787 in the year 1878 to 283 in 1900, so that the construction of daily synoptic weather charts begun by Dr. Meldrum about 1860 has had to be discontinued, except during cyclone weather.

THE Imperial Department of Agriculture for the West Indies has issued a second, and revised, edition of Mr. Maxwell-Lefroy's pamphlet on "The General Treatment of Insect Pests." Another of the pamphlet series, No. 11, "Hints for School Gardens," by the technical assistant, Mr. William G. Freeman, has just been published. It deals, in simple language, with the most elementary principles of agriculture, taking box and pot cultivation as the starting point for school work, and going on to gardening—growing vegetables and flowers and experimenting with manures. Mr. Freeman has written a useful handbook, which should be studied by teachers with Mr. Watts's "Nature Teaching" recently noticed here.

IN his annual report on the Antigua Botanic Station, Mr. W. N. Sands, the curator, gives a complete summary of the work for the year ending March 31, 1901. The most interesting feature of the report is a detailed account of an experiment designed to ascertain what a small plot of land about the size of a peasant garden or negro ground would produce in provisions, if properly managed and arranged. The usual method adopted by the peasantry is to grow one or two crops only, and for which they have to wait about five months for a return, which is often poor, and then selling out for a few shillings, often pence. At the Botanic Station a patch 1/10 acre in extent, and overgrown with grass, was taken in hand, and, having been duly cleared, forked and manured, nineteen varieties of vegetables were sown or planted at various periods. In due time such of them as matured were reaped, and sold locally. The sum realised for the produce of the patch was 2*l.* 15*s.*, the expenditure having been 1*l.* 15*s.* 3*d.* Of the latter sum, however, 1*l.* 4*s.* 8*d.* was expended on labour, which would not come out of the peasant's pocket, as he would attend to his garden in his spare time. By the exercise of a little intelligence, therefore, a peasant could make a profit of 2*l.* 4*s.* 5*d.* out of 1/10 acre of land in nine months.

THE most important paper in the *Transactions* of the Hull Scientific and Field Naturalists' Club for 1901 is one by Messrs. F. W. Mills and R. H. Philip on the diatoms of the Hull neighbourhood. It is illustrated by no less than sixteen plates, drawn by the first-named author.

THE October issue of the *Bulletin* of the Cracow Academy of Sciences contains an important article, by M. Godlewski, on the development of muscular tissue in mammals; and a second, by M. Przesmycki, on certain protozoans parasitic in rotifers. Both are elaborately illustrated.

M. ARMAND GAUTIER contributes to the *Revue Générale des Sciences* of December 15, 1901, an article entitled "Les Mécanismes moléculaires de la Variation des Races et des Espèces," taking as his text the experiments in hybridisation made of late years with the French and American species of vine.

MANY animals have popular names which have been derived from their cries. Prof. T. D. A. Cockerell writes to suggest that this is also the case with the donkey, the "don" representing the inspiratory and "key" the expiratory sound. Most dictionaries describe the word, which is of comparatively recent origin, as signifying a little dun animal, from dun and the diminutive term—key, but the grounds upon which this derivation is based are not easy to find.

TO the *Proceedings* of the Washington Academy of Sciences (vol. iii. pp. 577–600) Dr. C. H. Merriam contributes a paper on the various local forms of the puma. It has long been recognised by naturalists that an animal with such an extensive range must be divisible into a considerable number of geographical races; but Dr. Merriam goes further than this, and considers that several of these ought to rank as species. If such a course were generally adopted it would be advisable to make the puma the type of a genus. Dr. Merriam remarks that these animals are very subject to cleft palate.

WE have received reprints of a series of articles from the November issue of the *Journal* of the Quekett Microscopical Club. In one, Mr. W. Wesche describes a new male rotifer from Hampstead Heath, while Mr. C. F. Rousselet treats of a new species of the same group in a second. In a third, Mr. D. J. Scourfield has notes on the manner in which the fresh-water polyp hydra suspends itself from the surface-film of water. In a note on "red rain dust" from Australia, Mr. G. H. Karop shows that, in addition to mineral matter, the substance in question contains a certain number of diatoms, and a percentage of what appear to be sponge-spicules.

WE have received the first number of a new journal, *The Emu*, published at Melbourne, which is to be the organ of the Australasian Ornithologists' Union. In the introductory notice the editor discusses the question whether the name of the bird from which the journal takes its title should be spelt "emu" or "emeu." We are told that the native pronunciation is *emyoo*; and if this be so, according to accepted ideas of transliteration *emeu* makes a nearer approximation to the original than *emu*, which would now be pronounced *emoo*. The number before us contains some interesting articles and a couple of excellent photographs of breeding colonies of gannets and frigate-birds. The new venture ought to have a successful future.

A SHORT time ago we noticed a communication by Prof. T. H. Morgan on the regeneration of limbs and other parts of the body in animals. The same investigator contributes to the December issue of the *American Naturalist* an article on regeneration in the egg, embryo and adult. Within the last few years it has been ascertained that portions of an embryo, or even of an unsegmented egg, have the power of producing a new organism; but it has not been determined whether regeneration of parts of an adult organism and of pieces of an egg are similar or identical processes. The author answers the question in the affirmative, but denies that there is any analogy between this process and the natural reparation of a broken crystal. Nevertheless, he connects this recuperative process in animals with a kind of organic "polarity."

THE Christmas number of the *Stock-keeper* is largely devoted to illustrations and descriptions of famous specimens of the more popular breeds of domesticated dogs. The editor, it appears, offered a number of prizes for the best photographs of well-bred dogs by amateurs, and the successful pictures, together with many others, have been reproduced as photogravures in the present issue. Attention is called in an article on the results of the competition to the importance of preserving photographs of the modern breeds of dogs, and regret is expressed that we possess no such records of their predecessors. It may be added that it would be of the highest importance if arrangements could be made for taking photographs of dogs (and other domesticated animals) from above as well as from in front and from the sides.

IN their fifteenth annual report the Liverpool Marine Biological Committee refer with satisfaction to the arrangement concluded with the Government of the Isle of Man whereby they will in future enjoy much larger laboratory accommodation, and, jointly with a committee of the Tynwald Court, be responsible for the conduct of a large aquarium and fish-hatchery. A detailed statement as to how this important change in the position of the committee has been brought about is given, while its probable effects on their work are also mentioned. The greatness of the change may be realised when we state that it involves the moving of the present biological station to a larger and more convenient site on the other side of the bay. The work accomplished during the past year appears to have been large and of a satisfactory nature. The report contains an excellent popular guide to the Port Erin Aquarium, illustrated by figures of a large number of its denizens. Prof. Herdman is to be congratulated on the continued progress of the institutions the interest of which he has so much at heart.

A NOTICE of the collections recently bequeathed by the late Mr. Philip Crowley to the natural history branch of the British Museum appeared a few days ago in *The Times*. A very important portion of the bequest is the collection of eggs, from which 15,200 specimens have been added to the series previously possessed by the Museum. Among the gems in the Crowley cabinet are an egg of the great auk and one of the extinct pied Labrador duck. Both these specimens were acquired by Mr. Crowley from Canon Tristram. The great auk's egg is one of the last "batch" despatched, in 1844, from Iceland to Denmark. The two specimens in the Museum previous to this addition were both cracked and in otherwise poor condition. An interesting item in the collection is the number of clutches of eggs of various species of birds with a cuckoo's egg among them. The Crowley collection has added about 15 per cent. to the species of birds represented by their eggs in the Museum, the increase being especially marked in Australian forms, in which the national collection was previously weak. In addition to eggs, the Museum also acquired a large series of invertebrates, especially butterflies, from the Crowley collection. The article concludes with a reference to the valuable series of specimens from the Uganda district recently presented to the Museum by Sir Harry Johnston. Apart from the okapi and five-horned giraffe, this collection includes a valuable series of fishes from Lakes Victoria and Barengo—the first ever obtained from these waters.

A CATALOGUE of the Mediterranean algæ is commenced by Prof. Francesco Ardissone in the Lombardy *Rendiconti*, xxxiv. 17. The first part deals with Rhodophyceæ, and the author has decided, for stated reasons, to adopt Agardh's classification.

THREE additional volumes of the Yale University Bicentennial Publications have been received. Two contain studies from the chemical laboratory of the Sheffield Technical School, edited by Prof. H. L. Wells, and the third is a text-book on vector analysis, for the use of students of mathematics and

physics, founded upon the lectures of Prof. J. Willard Gibbs by Dr. E. B. Wilson. The volumes can be obtained in London from Mr. Edward Arnold.

THE kinematograph is now so frequently employed to reproduce the characteristics of moving objects and scenes that everyone is familiar with its pictures. But twenty years ago, when Mr. Muybridge projected before an audience at the Royal Institution a series of moving pictures illustrating animal locomotion, the results were regarded as veritable photographic triumphs. Since then photography has been utilised in the analysis of motions of many animate and inanimate objects, but Mr. Muybridge's collection of pictures is still the standard work on the various changes which take place in the disposition of the limbs and body of common animals during motion. A cheap edition (price 20s.) of the plates illustrating "The Human Figure in Motion" has been published by Messrs. Chapman and Hall, and will doubtless be appreciated by artists and students of anatomy who are unable to study the elaborate work in which the pictures originally appeared.

THE "Annuaire" of the French Bureau des Longitudes is a wonderful repertory of statistical and other information requiring frequent revision if it is to represent existing conditions of knowledge. In the volume for 1902, received a few days ago, we notice that all the dates are expressed in mean civil time, reckoned continuously from 0 hour to 24 hours, and beginning at midnight. The catalogue of minor planets has been brought up to October 2, 1901. M. E. Levasseur brings the statistics of the population of Europe up to the end of October last; and the magnetic elements of the chief places in France are given for the epoch January 1, 1902. As in previous years, there are articles on subjects of wide scientific interest. To the present "Annuaire" M. H. Poincaré contributes an article on telegraphy without intervening wires; M. A. Cornu writes on polyphase currents; M. E. Guyou on the application of the decimal division of the quadrant of a circle to navigation; and M. J. Janssen on the establishment and work of the observatory on the summit of Mont Blanc.

THE as yet unanswered question concerning the source and mode of production of the free electricities, which appear on the separation of two heterogeneous bodies which have been in contact, is the subject of an interesting paper by O. Knoblauch in the last number of the *Zeitschrift für physikalische Chemie*. Seventy-five different substances of various characters were brought into contact with plates of platinum, paraffin, sulphur, and glass, and the positive or negative character of the charge received by the plate on separation was in each case determined. By the assumption of an absorbed film of water on the surfaces of these different bodies, the author finds it possible by application of well-known principles of the ionic theory to account for the character of the charge received by the one substance after it has been in contact with a second.

THE additions to the Zoological Society's Gardens during the past fortnight include a Vervet Monkey (*Cercopithecus lalandii*) from South Africa, presented by Captain B. Head; ten Crab-eating Raccoons (*Didelphys cancrivorus*) from South America, a Gangetic Trionyx (*Trionyx gangeticus*) from the Ganges, fifteen Tigrine Frogs (*Rana tigrina*) from India, deposited; a Crimson-breasted Barbet (*Xantholoema haematocephalus*) from India, a Variegated Sheldrake (*Tadorna variegata*) from New Zealand, purchased; a Campbell's Monkey (*Cercopithecus campbelli*) from West Africa, presented by Mr. F. R. Paxman; a Green Monkey (*Cercopithecus callitrichus*) from West Africa, presented by Dr. Gray; a Bonnet Monkey (*Macacus sinicus*) from India, presented by Mr. D. Justice.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN JANUARY.

Jan. 3. Epoch of January meteoric shower (radiant 230°+53°).
5. 11h. 28m. Minimum of Algol (β Persei).
8. 8h. 17m. Minimum of Algol (β Persei).
9. 10h. Saturn in conjunction with the sun.
9. 15h. Venus at greatest brilliancy.
11. 5h. 5m. Minimum of Algol (β Persei).
12. 4h. 17m. to 5h. 27m. Moon occults c' Capricorni (mag. 5·2).
12. 18h. Venus in conjunction with moon. Venus 3° 8′ S.
13. 6h. 23m. to 7h. 1m. Moon occults κ Aquarii (mag. 5·5).
15. Venus. Illuminated portion of disc = 0·218, Mars = 0·990.
15. 11h. Jupiter in conjunction with sun.
21. 8h. 15m. to 8h. 39m. Moon occults 71 Orionis (mag. 5·1).
22. 16h. 56m. to 17h. 28m. Moon occults 68 Geminorum (mag. 5·0).
24. 6h. 7m. to 7h. 1m. Moon occults κ Cancri (mag. 5.0).
24. 17h. 23m. to 18h. 0m. Moon occults ω Leonis (mag. 5·6).
26. 18h. 38m. to 19h. 30m. Moon occults p^5 Leonis (mag. 5·5).
27. 21h. Juno in conjunction with moon. Juno 1° 11′ N.
28. 9h. 59m. Minimum of Algol (β Persei).
31. 6h. 48m. Minimum of Algol (β Persei).

STARS NEAR NOVA PERSEI.—Prof. Ceraski reports in the *Astronomische Nachrichten* (Bd. 157, No. 3755) that on a photograph obtained on the night of 1899 January 30 there is a small star very near the position at present occupied by the Nova. Visual observations with a 15-inch telescope now fail to locate the star, and he asks astronomers with powerful instruments at their disposal to examine this region. The coordinates with respect to the Nova Persei are:—

R.A. = α Nova + 0ˢ·31.
Decl. = δ Nova − 7″.

As estimated from the photograph, the star would be of about the 12th magnitude.

MAGNETIC OBSERVATIONS DURING TOTAL SOLAR ECLIPSE.—In the *Journal of Terrestrial Magnetism and Atmospheric Electricity* (vol. vi. pp. 123–143) reports are presented showing the details of observations of the magnetic declination, horizontal and vertical forces during the total solar eclipse of May 17–18, 1901. The stations employed for the determinations given in this issue were at Pola, Austria; Val Joyeux, France; Groningen University, Holland; De Bilt Observatory, near Utrecht; Flushing, Holland. Further reports will be published later, and the whole discussed with the object of investigating the perturbations due to extra-terrestrial causes.

THE TOTAL SOLAR ECLIPSE, MAY 18, 1901.—In *Popular Astronomy* for December, 1901, Prof. E. E. Barnard gives a long description of the preparation, equipment and preliminary experiments undertaken in connection with the last eclipse, and although the weather conditions prevented any positive results being obtained, the record of his methods of dealing with apparatus on such great scale—the plates used were 40 × 40 and 30 × 30 inches—will be of considerable interest and value to workers on future occasions.

NATAL OBSERVATORY REPORT FOR 1900.—The report recently issued by the Government Astronomer of Natal contains as a supplement the details of the observations at the various meteorological stations throughout the colony during the year 1900, with summaries. The returns of several stations are unavoidably incomplete in consequence of the unsettled state of the country.

The instruments, with the exception of the 8-inch Grubb equatorial refractor, are in good order. This instrument will, it is hoped, be shortly dismounted and thoroughly overhauled.

The system of time signals is now established over the colony and is working satisfactorily.

PRIZE AWARDS OF THE PARIS ACADEMY OF SCIENCES.

AT the annual meeting of the Academy of Sciences, held on December 16, 1901, the presidential address was given by M. Fouqué and the following prize awards were announced:—

Geometry.—M. Léonce Laugel is awarded the Francœur prize and M. Émile Borel the Poncelet prize.

Mechanics.—The extraordinary prize of six thousand francs is divided between M. Tissot for his work relating to the utilisation of wireless telegraphy in the Navy, and M. Marbec for his calculations on the strength of tubular boilers; M. Aimé Witz receives the Montyon prize, and M. Boulvin the Plumey prize for his applications of the entropy diagram to the steam engine. The Fourneyron prize, the subject proposed for which was the theoretical or experimental study of steam turbines, is not awarded.

Astronomy.—The Lalande prize to M. Thome, and the Valz prize to M. Charles André for his treatise on stellar astronomy.

Physics.—The La Caze prize is awarded to M. Curie for his work on radium and on piezo-electricity of crystals, the Gaston Planté prize to M. G. Boucherot, the Kastner-Boursalt prize to MM. H. Gall and de Montlaur for their electrochemical work.

Statistics.—The Montyon prize for statistics is given to M. G. Baudran for his work on tuberculosis in the Department of the Oise, a very honourable mention being accorded to the memoir of MM. Delobel, Lebrun and Cozette on the statistics of contagious diseases of animals in France, and to M. Lowenthal.

Chemistry.—The Jecker prize is divided between MM. Moureu, Simon and Léo Vignon, MM. Wyrouboff and Verneuil receiving the La Caze prize for their researches on the rare metals.

Mineralogy and Geology.—The Delesse prize is awarded to M. Gaston Vasseur for his work on the classification of the Tertiary strata in the west and south-west of France.

Physical Geography.—The Gay prize is divided between MM. Franchet and Saint-Yves.

Botany.—MM. Matruchot and Molliard receive the Bordin prize for their work on the influence of the external conditions on the protoplasm and nucleus in plants, M. Karl E. Hirn the Desmazières prize, M. Mazé the Montagne prize for his researches on the mechanism of the fixation of nitrogen by the Leguminosæ, M. Ferdinand Debray the de la Fons-Mélicocq prize, and M. N. Patouillard the Thore prize for his taxonomic essay on the families and genera of the Hymenomycetes.

Anatomy and Zoology.—The grand prize of the Physical Sciences is awarded to M. Maupas for his two memoirs on the biology and the origin of the sexual elements in Nematods, and the Savigny prize to MM. Jules Bonnier and Ch. Pérez for their exploration of the Red Sea and the Persian Gulf.

Medicine and Surgery.—The Montyon prize is divided between MM. Buffard and Schneider, Lignières, and Claude and Balthazard, the Barbier prize between MM. Moreigne, Tissier, and Goyon, the Breant prize in equal parts between MM. Jules Courmont and V. Montagard, Weil, and Levaditi; M. René le Fur receives the Godard prize, M. Gley the Mége prize, whilst the Bellion prize is divided between MM. Landouzy and G. Brouardel, and M. Sauton, very honourable mentions being accorded to M. Razou and M. Pégurier. The Lallemand prize is divided between MM. Catois, J. C. Roux and J. Lépine, MM. F. Bernheim and A. Comte receiving very honourable mention. M. Catrin receives the Baron Larrey prize for his work on mental alienation in the Army, an honourable mention being accorded to MM. Tostivint and Remlinger for their memoir on the comparative pathology of the European and Arabian races.

Physiology.—The Montyon prize for experimental physiology is awarded to M. Marcel Mirande, M. Bonniot being accorded an honourable mention, the Pourat prize to M. Tissot for his researches on the cooling due to muscular contraction, the La Caze prize to M. Charpentier, the Philipeaux prize being divided between MM. L. Camus and M. Moussu.

General Prizes.—The Lavoisier medal is awarded to M. Emil Fischer, professor of chemistry at the University of Berlin, correspondant of the Academy, for the whole of his works and in particular for those relating to the syntheses of the sugars. The Montyon prize (unhealthy trades) is divided between MM. Albert Dormoy and L. Vaillard, M. Halphen receiving an encouragement. M. Baubigny receives the Wilde prize for his work on atomic weights, MM. Fosse and Grignard the Cahours prize (in equal parts), P. Stanislas Chevalier the Tchihatchef prize for meteorological and astronomical studies in China, M. Gabriel Lippmann the Jean Reynaud prize, M. F. Foureau the Leconte prize for his scientific explorations in southern Algeria, M. Foureau the Janssen gold medal, and MM. N. Villatte, E. Verlet-Hanus and A. P. de Chambrun silver gilt medals for their work in the Sahara, M. Gabriel Kœnigs the Petit D'Ormoy prize for his researches in geometry and mechanics, M. Bouvier the Petit D'Ormoy prize (natural sciences), M. Guichard the Saintour prize, M. A. Ponsot the Gegner prize, M. Frémont the Trémont prize.

The Baron de Joest prize is divided between MM. Verschaffel and Saint-Blancat for their astronomical work, the prize founded by Mme. la Marquise de Laplace being given to M. Japiot, and that founded by M. Félix Rivot to MM. Pellarin, Ott, Japiot and Guillaume.

ELECTRIC WAVES.

THE annual meeting of the German Association of Men of Science and Physicians was held last autumn in Hamburg. It is twenty-five years since the Association last met in the birthplace of Heinrich Hertz, who was then a young man of nineteen, not yet entered upon the active period of his life, which ended by his death in 1894, and which, though so short, was yet so great and full of usefulness. It fell, therefore, to the lot of Prof. Ernst Lecher to deliver this address[1] in memory of Hertz and to review the further development, which has taken place since his death, of his greatest work, the experimental proof of the existence of electric waves.

It is, indeed, a long chain of events, as Hertz himself expressed it, to which the discovery of electric waves belongs, one event linking itself into another, the whole forming perhaps the most noble and convincing proof that our modern methods of scientific thought and research are true and exact. Prof. Lecher gives an interesting sketch of this in the pamphlet before us. The first link in the chain was forged by Faraday. Until his time the scientific world was dominated by the old Newtonian ideas of force acting at a distance, an idea which seems to us now, on close examination, to be manifestly absurd. It required, however, the genius of Faraday to break loose from this line of thought and to perceive that a medium is necessary in order that one body may exert a force upon another; and to the eye of Faraday the whole of space became filled with lines and tubes of force, real changes of condition in the intervening media, which, although invisible, were as clear to him as the objects acted upon themselves. The way was thus paved for Maxwell, who collected these ideas in his really magic formulæ of the electrodynamical theory of light. According to Maxwell there are electric currents in insulators, these being of the nature of displacement currents. Although these currents are of very short duration, yet they must have like magnetic and inductive effects to the ordinary currents in a conductor. If, now, a displacement current vibrates backwards and forwards, then in a neighbouring insulator displacement currents will be induced, and so forth; a transversal wave-motion is thus propagated until it is absorbed by induction in a conductor and transformed into heat. On calculating the velocity of this wave propagation it was found that two quantities appeared in the result—the dielectric coefficient and the permeability. The square of the velocity is equal to the reciprocal value of the product of these two values. It was found, however, that whole powers of this value were always appearing in different branches of the theory of electricity, and, most extraordinarily to say, the value was always found to be equal to the velocity of light. Maxwell, therefore, came to the theoretical conclusion in 1865 that an electromagnetic wave must travel in an insulator, *e.g.* in air or vacuum, with the velocity of light. But not only the velocity, concluded Maxwell, should be the same, but also the geometrical and other properties must be equal; a ray of light was therefore a series of electric waves, light was electricity. These ideas, immediately after their enunciation by Maxwell, did not meet with any great acceptance, and an experimental proof of their accuracy was looked upon as being altogether out of the question. This feeling was even shared by Hertz himself, for in his description of his classical experiment where, by means of a

[1] Ueber die Entdeckung der elektrischen Wellen durch H. Hertz und die weitere Entwicklung dieses Gebietes. (Leipzig: Johann Ambrosius Barth.

spark gap in a loop of wire, he showed the sparks induced by the electric waves at a distance of ten metres from the transmitter, he said: "It appears impossible, nearly nonsensical, that these sparks should be visible, but in a perfectly dark room they *are* visible."

Since the death of Hertz it can hardly be said that another link in the chain of development has been forged. Our knowledge and study of electric waves have spread and expanded enormously, and the practical utilisation of the same is seen in the modern wireless telegraphy. The possibility, as Marconi has shown, of already sending messages without the use of wires for a distance of 300 kilometres is the direct result of the labours of Hertz. From a theoretical standpoint the work of the many investigators of the last few years has simply increased the burden of proof that the fundamental ideas of the electrodynamical theory are correct. Many points, however, yet remain to be cleared up. In the domain of the ether itself very few difficulties have been encountered. Very different has been the case when the ether pure and simple has been left and the theory and ideas extended to ordinary bodies and materials. Chief among these difficulties must be mentioned the phenomena of anomalous absorption and dispersion, and the relative interaction of mass and ether is to-day one of the most perplexing and yet enticing fields of scientific work. Perhaps here we are, though it is not mentioned in the pamphlet, just commencing the forging of yet an entirely new link, which will be seen in the full development of the corpuscle and electron theories, and the explanation of the many at present very strange phenomena included under these names. Besides being a very interesting address, this booklet would be very useful in serving as an index to the many investigations which have been made and published in this branch of science. C. C. G.

THE CIVILISATIONS OF HALLSTATT AND LA TENE.[1]

THE publications of the Prehistoric Commission of the Imperial Academy of Science in Vienna, in their present form, date from the year 1887, when it was resolved to discontinue the practice of publishing their reports as integral parts of the *Transactions* of the Academy. The primary object of this commission was to prosecute palæo-ethnographical investigations throughout the Austrian dominions, taking special care that the necessary excavations would be conducted in a thoroughly scientific manner. Since 1887 five parts, in all 363 pages, in quarto, with plates and numerous illustrations in the text, have been issued, giving on an average only twenty-eight pages per annum—a rate of progress which, *primâ facie*, does not suggest that such researches are advancing with rapid strides in that part of Europe. Looking, however, at the contents of the various papers and reports, which range over the whole field of prehistoric archæology, I am constrained to say that, in forming a fair estimate of the archæological value of the labours of the commissioners, we must be guided by quality and not by quantity.

The part now before me (No. 5) contains two papers, one by Dr. Moritz Hoernes and the other by Mr. Josef Szombathy, both officials in the prehistoric department of the K.K. Naturhist. Hofsmuseum in Vienna. Dr. Hoernes describes five different groups of antiquities from the vicinity of Vukovar, on the south side of the Danube and not far from the great bend which the river makes in changing its course from south to east. One group consists of the débris of a settlement of the Stone Age, two—one being a hoard—are of the Bronze Age, while the remaining two are respectively interments of the Hallstatt period and of Slavish times (eleventh or twelfth century). The first station, which bears the name Vučedol, is considered of some importance inasmuch as its relics, especially the pottery, illustrate the evolution of ornament; and so the author discusses at some length the points of resemblance and difference between them and those of a number of other analogous stations, such as Butmir (Bosnia), Tordos (Transylvania), Sarvas, near Essegg (Slavonia), the lake-dwellings of Laibach Moor, &c. But as Dr. Hoernes' opinions on these matters are already known, or at any rate accessible, to archæologists through his great work on the history of prehistoric art in Europe ("Urgeschichte der bildenden Kunst in Europa," Wien, 1898). I shall pass on to the next paper, which, having an important bearing on the development of the early Iron Age in Europe, is of some consequence to British archæologists who may be desirous to trace the late Celtic remains of their own country to their proper source.

Mr. Szombathy's valuable monograph, "Das Grabfeld zu Idria bei Bača," takes the form of a report on excavations made, in 1886 and 1887, in forty-seven graves discovered in the valley of the Idria in the Julian Alps. The little cemetery, occupying an area of 5 to 10 metres in breadth and 30 metres in length, is situated on the right bank of the river some 20 metres above the river-bed and about an hour's walk to the south-east of the great necropolis of Santa Lucia—one of the most famous landmarks of the Hallstatt period in Europe. These graves had, on the average, a depth of one metre and a breadth and length of 50 to 80 centimetres; and all of them, with the exception of two, contained interments after cremation. They are numbered in the order in which they were excavated, but in the report they are described in chronological sequence beginning with the oldest, *i.e.* the middle Hallstatt period (about 600 B.C.). As this sequence comes down to late Roman times we have in the contents of the cemetery of Idria a remarkable evolutionary series of remains, extending over a period of nearly 1000 years. The successive stages of civilisation disclosed by the investigation, together with the number of graves assigned to each, are as follows:—Middle Hallstatt represented by 1 grave, late Hallstatt by 13, early La Tène by 2, middle La Tène by 13, late La Tène by 7, early Roman by 8, and late Roman by 2.

Mr. Szombathy's description of the relics, with 212 illustrations in the text, is a model of precision and brevity, without any lack of essential details, and therefore admits of no curtailment. The following remarks will, however, give readers some idea of their salient features.

Ornaments.—Among this class the fibulæ are the most interesting. One or two, of the boat-shaped type, having a long, straight foot, belong to the middle Hallstatt period. The Certosa fibula and its contemporary the cross-bow fibula are respectively represented by fourteen and three specimens. The La Tène fibulæ—early, middle and late forms—are numerous, and well worth careful study by those who have not acquired precise notions of the progressive stages thus designated. Five hinge fibulæ, peculiar to Roman remains, complete the list. Among the early La Tène group there are two very remarkable, if not unique, specimens. These are ornamented with amber beads placed in pairs on five pins projecting from the upper surface of the bow and attached to a bronze wire which, in a succession of small, graceful coils, follows the curve of the bow from head to foot. The middle La Tène specimens have the recurved foot ending in a circular expansion, which appears to have contained a setting of some kind of enamel. Iron fibulæ are scarce. The other objects of personal ornament consist of earrings, studs, finger-rings (one with three twists), bracelets with one or more coils, glass beads and torques.

Vessels.—Bronze caldrons and situlæ with movable handles, round or flat bottoms, and bulging, slanting or upright sides, are well represented. Two bronze dishes, one of the milk-plate type (5½ inches wide and 3¾ inches deep) and the other a small bowl with a ring-handle, have *graffiti* inscriptions on the outside of their rims, said to be in Venetic or old North Etruscan alphabet. A small bronze colander is perforated in such a manner as to form a geometrical pattern consisting of a central rosette surrounded by a fret border. Pottery is not abundant, and only a shallow dish, one or two jars with handles, and a conical vase with expanded base and slightly contracted mouth are figured.

Military Accoutrements.—A bronze helmet, with a projecting rim and central ridge, has an inscription in Roman characters scratched on it which reads *Protemus.*—There are also two iron helmets said to be of Roman workmanship. Among the weapons are a characteristic La Tène sword and sheath, both made of iron. Two other iron blades, also with their sheaths, are supposed to be like the Roman gladius. The iron blade in both specimens is separated from the grip (only the long tang of which now remains) by a circular guard of bronze. The sheaths were imperfect, but they appear to have been made of an iron frame, with panels of bronze and some non-durable material probably wood. There are also several spearheads, a knife-dagger still in its iron sheath and some fragments of shields showing conical bosses—all made of iron.

Industrial remains.—In this category are to be placed a

[1] "Mittheilungen der Prähistorischen Commission der K. Akademie der Wissenschaften in Wien." (Band i., No. 5, 1901.)

varied assortment of iron objects, such as knives, chisels, axes with flanges on one or both sides, axe-hammers with transverse sockets, scythes and sickles very similar to those from Oppidum La Tène, buckles, shears, shovels, ploughshares and coulters, the central portion of a bridle-bit, &c.

A bronze statuette.—One of the late Hallstatt graves contained a bronze figure of a beardless man, 12 centimetres in height. The body is clad in a closely-fitting tunic with a prominent girdle, leaving the neck, forearms and legs exposed. On the left arm is an armlet, on the left leg an anklet, and on the head a helmet. The bare feet rest on a small round pedestal. The gaze is directed to the palm of the upraised right hand, while the left arm is bent sidewards as if the half-closed fist were grasping the handle of an upright spear.

One of the most novel features of the cemetery was the proportionately large number of agricultural and domestic implements which it contained. While analogous cemeteries in other localities, such as the neighbouring necropolis of Santa Lucia, have yielded an endless array of objects of personal adornment, as well as others intended exclusively for votive purposes, here at Idria the grave-goods consisted of utensils, implements, weapons, tools and ornaments actually used in everyday life. Mr. Szombathy, however, observes that this peculiarity was more noticeable in the interments of the later half of the period during which the cemetery was in use.

Another equally noteworthy feature was that objects of different periods were not unfrequently found in the same grave—a fact accounted for by the tendency to continue old customs in secluded mountain valleys, such as that of Idria. This overlapping of different culture periods complicates, to some extent, the task of delineating the successive phases of the early Iron Age civilisation.

As to the racial question, Mr. Szombathy speaks by no means dogmatically. The earlier grave-goods indicate a civilisation so like that of Santa Lucia that its founders were probably of the Illyrian stock; but whether the same people continued in the Idria valley during the intrusion into it of the later Celtic and Roman culture-elements there is no evidence to show. Possibly the deciphering of the inscriptions on the bronzes, of which there are three or four, may help to solve the problem.

The frequency with which the generic expressions "Hallstatt" and "La Tène" are now used in the archæological literature of Europe renders it essential for British antiquaries to acquire precise ideas of the culture-elements represented by them. For the origin of the word "Hallstatt" we have to go back to the investigation of a cemetery in a small valley of the Noric Alps in the vicinity of Lake Hallstatt, and for that of "La Tène" to the well-known station of that name at the north end of Lake Neuchâtel. Subsequently these terms were used to designate similar remains found in widely-separated districts, just in the same way as the term "Mycenæan" is no longer restricted to the discoveries at Mycenæ. Practical researches have now greatly extended the culture-elements, both in number and types, which have to be classified under Hallstatt and La Tène, and it has often been mooted whether a better nomenclature could not be devised. I do not think it would now be advisable to make any change in this respect. What, however, is urgently required with regard to these terminal links in the development of the Iron Age in Europe is an authoritative work dealing with the essential characteristics of the relics discovered within their respective archæological areas. For records of the rich finds made in Central Europe since the appearance of "Das Grabfeld von Hallstatt" by v. Sacken, and in the cemeteries of Glasinac and Jezerine in Bosnia, as well as in those of the Istrian peninsula and the valley of the Po, we have to hunt in the *Transactions* of so many societies that they are, practically, inaccessible to all but a few specialists. Knowing the competency of Austrian archæologists for executing such a work, and the ample resources, by way of illustrations, at their command, I trust this suggestion will not remain fruitless.

ROBERT MUNRO.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE difficulty in connection with Mr. Carnegie's offer to found a National University (see p. 164) has been solved by the donor's arranging to convert into Government bonds the ten million dollars' worth of United States Steel Corporation bonds, the acceptance of which was an obstacle to the adoption of the scheme.

OUR national deficiencies in regard to provision for higher scientific and technical education are obvious to all who take the trouble to inquire into the matter. For many years men of science have been watching with a feeling akin to envy the opportunities provided for scientific instruction and investigation by foreign nations, and comparing them with the elementary efforts at technical education here. The facts which have been given in these columns week after week have made our readers familiar with existing conditions of technical education; and it is impossible not to be dismayed at the country's prospects in the industrial wars of the future when the inadequate way in which our industrial leaders are trained is understood. A pamphlet just published by the Association of Technical Institutions, giving a comparison of technical education at home and abroad, again brings the subject before the attention of the public. In the matter of buildings and equipment for the highest kinds of technical work we are still far behind Germany, Switzerland and America. Two diagrams published in Nature in 1898 (vol. lviii. p. 54) show clearly how Continental institutions for instruction and research work in technical or applied science are provided on a scale which vastly exceeds ours both as regards areas of sites and areas of buildings. Both these diagrams are reproduced in the pamphlet just mentioned, and also those w hich

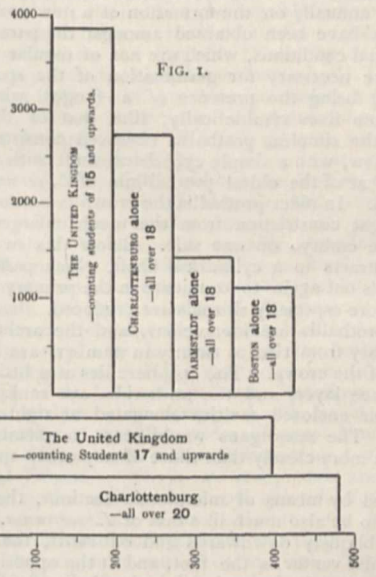

FIG. 1.

FIG. 2.

FIG. 1.—Diagram comparing approximately the number of Students above 15 years of age taking complete Day Technological Courses in the whole United Kingdom, with the numbers of similar Students above 18 in single Institutions in Germany and America.

FIG. 2.—Diagram comparing approximately the number of third and fourth year Students above 17 years of age taking complete Day Courses in Engineering in the United Kingdom, with the number of similar Students above 20 in a single German Institution.

accompany this note. In these diagrams we have some results of an inquiry made by the association as to the number of day students fifteen years of age or more who are taking complete regular day technological courses of not less than twenty hours a week. Statistics were obtained from Universities, University Colleges, technical schools and all similar institutions where day technological courses are given. The results of the inquiry show that in comparison with other countries our attempts at technical education are utterly futile. In the whole country there are only 555 third-year students of technology satisfying the conditions described, and 113 fourth-year students. The total number of third-year students in engineering is only 347, and of fourth-year students 52, and this number is only obtained by counting students who begin their studies at the immature age of fifteen. As the accompanying diagram (Fig. 1) shows, there are more than two-thirds as many regular day students above eighteen years of age at the Charlottenburg Technical High School, Berlin, as there are above fifteen years of age taking

complete day technological courses in the whole of the United Kingdom. If only day students of technology more than eighteen years of age are considered, there are less in our country than in any large technical institution in Germany or America, as indicated in Fig. 2. With facts like these to consider, the future of our country cannot be contemplated without misgiving. When will our political leaders take up the subject of secondary and technical education seriously, and insist upon proper provision being made for it by greatly increased funds from national and local sources? The apathy displayed in regard to technical training by both employers and employed is largely due to the drifting policy of the Government and the sacrifice of future interests to present expediency.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, December 5, 1901.—"Preliminary Account of the Prothallium of Phylloglossum." By A. P. W. Thomas, M.A., F.L.S., University College, Auckland, N.Z. Communicated by Prof. G. B. Howes, F.R.S.

The sporophyte generation of *P. Drummondii* is a small plant, growing from a tuber, which forms a tuft of a few cylindrical tapering leaves. The tuber is apparently comparable to the protocorm of *Lycopodium cernuum*, except that it is repeated annually on the formation of a new protocorm. The prothallia have been obtained amongst the parent plants, and very special conditions, which are not of regular annual occurrence, are necessary for germination of the spores, the most important being the presence of a fungus with which the prothallium lives symbiotically, like that of the Lycopods. One of the simplest prothallia observed consisted of an oval tuber below, with a simple cylindrical shaft with rounded apex, akin to that of the oldest prothallium of *L. cernuum* described by Treub. In older prothallia the crown is commonly separated by a slight constriction from the much enlarged body, which bears the embryo on one side. Below this swollen part the body contracts to a cylindrical shaft, which passes downwards and swells out again to terminate in the primary tubercle, from which more especially rhizoids are produced.

The prothallia are monœcious, and the archegonial necks, which vary from two to twenty in number, are a conspicuous feature of the crown. The oosphere lies at a little depth below the surface layer, and the antheridia are sunk in the crown, with their enclosed cavities elongated at right-angles to the surface. The sex-organs would seem to resemble those of *L. cernuum* more closely than those of any other species of Lycopodium.

Studied by means of microtomic sections, the development appears to be also much like that of *L. cernuum*. The embryo grows obliquely downwards and outwards, the part near the archegonial venter is the foot, and at the opposite end are the stem-apex and leaf, the tip of the leaf being the first part of the embryo to appear outside the prothallium. Immediately on escaping from the prothallium the embryo forms a protocorm, apparently in the same manner that the adult plant forms its annual tuber. The pedicel of the tuber elongates downwards until the latter is placed at a safe depth. In the meantime the leaf grows up, and although no root-formation has been observed during the first year, rhizoids may be developed on the pedicel and protocorm. The leaf becomes green even before it escapes from the prothallium, and as soon as it reaches a little above the soil stomata are formed, and a slender strand of tracheids in the centre. The first protophyll has the structure of a small leaf as produced in later years, and the later development of the sporophyte appears to be slow, the plant coming up in many cases a second and a third year with only a single leaf. A young prothallium was found quite colourless, except for a yellow tinge at the upper end, while two others still without sex-organs bore but scanty chloroplasts. But never was there a fully developed prothallium which was not green above. The prothallium is distinctly of Lycopod type, on the whole most nearly resembling that of *L. cernuum*, except that it lacks the leaf-like assimilatory lobes of this, and the simplicity of structure favours the view that Phylloglossum is a primitive form of Lycopod. It is recognised as a permanently embryonic form, but the simplicity of structure of the mature saprophyte does not necessarily prove it to be a primitive form of the Lycopodiaceous phylum.

Branching occurs in two ways. The spike or strobilus occasionally branches, and the branching always takes place above the lowest sporophyll, sometimes at the base of the spike or even near the apex of the strobilus. Even when the strobilus forks there is no transition of form between sporophyll and protophyll, and such leaves as have been observed on the peduncle some distance below the rest of the strobilus have always been of sporophyll type. Twenty was the largest number of protophylls found on a plant, but there is never a transition between protophylls and sporophylls. The view is entertained that the former may have arisen from the differentiation of the lower region of a sporogonium or its homologue, in which this region had acquired sterilised tissues, and that the sporophylls arose from the upper fertile region of the sporogonium. There appears to be no connection between the number of protophylls and reproduction by spores. The formation of two new tubers is common, and these may be found on opposite sides of the plant in a manner favourable to dispersion.

Phylloglossum is not semi-aquatic. It may grow upon a hill-top and as well upon a slope, and it was never found in actual swamp. There is little evidence that it owes its simplicity to reduction, and it is regarded as possibly the most primitive of existing Pteridophytes, while the simple character of the gametophyte and comparison of the mature sporophyte with the embryo of *Lycopodium cernuum* favour the view that it is the most primitive of existing Lycopodinæ.

The author has finished and despatched to London an elaborate and fully illustrated memoir upon this most important organism.

December 12, 1901.—"Contributions to the Chemistry of Chlorophyll. No VIII. Changes undergone by Chlorophyll in passing through the Bodies of Animals." By Edward Schunck, F.R.S.

The conclusions to which the experiments described lead are summarised as follows:—

(1) The fæces of animals supplied with green vegetable food only—such at least as have so far been examined—contain no chlorophyll, but in its place substances which must be supposed to be derivatives of chlorophyll, formed partly by the action of acids on the chlorophyll of the food, partly by some agency to which the latter is subjected in its passage through the body.

(2) Of these substances, one seems to be identical with phyll-oxanthin, a well-known product of decomposition of chlorophyll. Another is a substance of well-marked properties, nearly resembling, but not identical with, phyllocyanin. It has not, so far as the author's experience goes, been hitherto observed as a result of any process of decomposition to which chlorophyll has been subjected outside the animal body. He considers it as a body *sui generis*, characterised by its fine purplish-blue colour and its brilliant metallic lustre. The existence of other products in addition to these two is possible. On one occasion, indeed, a definite crystalline substance was obtained, which seemed to be peculiar, but that it was in any way connected with chlorophyll could not with certainty be maintained.

Royal Astronomical Society, December 13, 1901.—Dr. J. W. L. Glaisher, president, in the chair.—The secretary read a paper, by Prof. S. C. Chandler, on Sir G. Airy's reflex zenith tube. The history of this instrument had passed through various phases—in the beginning of great hopes, later of grievous perplexity, and finally of severe disappointment. All attempts to obtain parallax or the constant of aberration produced quite discordant results, and the observations had at last been practically abandoned. But Dr. Chandler now showed that these anomalous results were due to the relative motions of the earth's axes of rotation and figure discovered by him some ten years ago, and that the zenith-tube observations, so far from being useless, had provided us with an invaluable record of these phenomena. An analytical proof of these statements was given in the paper.—Prof. R. A. Sampson gave an account of the original MSS. of the late J. C. Adams on the perturbations of Uranus between the dates 1841 and 1846. It was shown that Adams made no less than six different solutions of the problem in this period, and that the first, completed in 1843, was much more complete than had been supposed.—Prof. Turner read a paper on a simple method of accurate surveying with an ordinary camera, in which he showed that results of great accuracy could be rapidly obtained by the photographic method.—Mr. Hinks gave a paper on the accuracy of measures on photographs,

especially in reference to recent papers on the subject by M. Lœwy and Mr. H. C. Plummer.—Other papers were taken as read.

Zoological Society, December 17, 1901.—Prof. G. B. Howes, F.R.S., vice-president, in the chair.—A communication was read from Mr. G. Metcalfe, M.A., of New South Wales, concerning the reproduction of the duckbill (*Ornithorhynchus anatinus*). The author stated that he was of opinion, after many years' observation of the animal, that the duckbill was viviparous and that the young were not, as was generally supposed, hatched from the eggs after they had been deposited.—Dr. C. I. Forsyth Major exhibited the skull of a fossil aquatic musteline animal, *Enhydrictis galictodes*, gen. et sp. nov., from the Pleistocene ossiferous breccia of the island of Sardinia, which he stated had affinities with both the neotropical Galictis and with the genus Trochictis from the Middle Miocene of European deposits.—Mr. J. S. Budgett read a paper (illustrated with lantern slides) on the structure of the larval Polypterus. His observations confirmed the belief that the Crossopterygians were a very generalised group of vertebrata, and he concluded that the particulars of structure in which other more recent groups agreed with these ancient types were probably of a primitive rather than of a secondary nature.—Mr. L. A. Borradaile read a paper on the spawn and young of a polychæte worm of the genus Marphysa from Ceylon, allied to, or identical with, *Marphysa teretiuscula*, Schmarda.—Dr. P. Chalmers Mitchell read a paper on the anatomy of gruiform birds, with special reference to the correlation of anatomical characters. The communication was based on dissections of birds belonging to the Rallidæ, Gruinæ, Araminæ, Psophiinæ, Dicholophidæ, Otididæ, Rhinochetidæ, Eurypygidæ and Heliornithidæ, the material consisting chiefly of birds that had lived in the Society's gardens.—Prof. F. G. Parsons read the first portion of a paper, prepared by himself and Prof. B. C. A. Windle, F.R.S., on the muscles of the Ungulata. This part dealt with the muscles of the head, neck and fore-limbs of these mammals.—Mr. F. E. Beddard, F.R.S., gave an account of the minute structures in the spermatophores of the earthworms of the genus Benhamia.—Mr. G. A. Boulenger, F.R.S., read some further notes on the African batrachians which he had recently described under the names *Trichobatrachus robustus* and *Gampsosteonyx batesi*. A communication was read from Dr. A. G. Butler consisting of a list of thirty species of butterflies of which specimens were contained in a collection sent home by Major A. H. Cowie, R.E., from St. Lucia, West Indies. One of the species was new to science, and was described under the name of *Cystineura cowiana*.

PARIS.

Academy of Sciences, December 23, 1901.—M. Fouqué in the chair.—On the periods of double integrals, by M. Émile Picard.—On the cultivation of clover on soils deprived of lime, by MM. P. P. Dehérain and E. Demoussy. The experiments described furnish two interesting examples of the influence of inoculation and of the medium on the growth of Leguminosæ; the clover grows in the soil of Brittany whenever lime and phosphates are used, that is, as soon as the medium becomes favourable to its vegetation; it remains poor, on the other hand, in a heath soil, in spite of the creation of a favourable medium, because garden earth does not carry the necessary bacteria.—Remarks by M. Bouquet de la Grye on the work done by the third general conference of weights and measures.—Remarks by M. E. Guyou on the annual of the Bureau des Longitudes for 1902.—On the measurement of the meridian of France by Méchain at the end of the eighteenth century, by M. G. Bigourdan. If to the measurements of Méchain, which formed the basis of the metric system, the corrections of Delambre are applied, the results are brought more nearly into line with the recent observations of Perrier.—On the observation of the annular eclipse of the sun of November 11, 1901, by M. A. de la Baume-Pluvinel. The observations, which were partly photographic and partly ocular, were made in Lower Egypt. Owing to the early hour at which the eclipse took place the ocular observations were the most satisfactory. One point to which especial attention was directed was the examination of the spectrum of the sun in the neighbourhood of the edge of the moon. A thickening of some of the Fraunhofer lines here would indicate the existence round the moon of a gaseous atmosphere capable of producing a sensible absorption. But no evidence of such a thickening could be obtained either from the negatives or from the direct observations, thus confirming the absence of a sensible atmosphere round the moon.—Remarks on the note of M. de la Baume-Pluvinel, by M. J. Janssen.—The calculation of real roots of equations, by M. A. Pellet.—The progressive calculation of the integrals of certain differential systems, by M. Riquier.—On the separation and calculation of the real roots of equations, by M. Raoul Perrin.—On the numbers e and π and transcendental equations, by M. Edmond Maillet.—On the most general motion of a solid body which possesses two degrees of freedom round a fixed point, by M. René de Saussure.—The laws of electrical energy, by M. E. Carvallo. A criticism of the two laws enunciated by Maxwell.—On a new application of optical observations to the study of diffusion, by M. J. Thovert. The two solutions are superposed in a plane-sided box and the deviation of a horizontal light ray measured. The deviation is proportional to the rate of change of the concentration with the vertical ordinate. The diffusion of a solution of sodium chloride into water was measured by this method and the results were found to be in accord with the theoretical expression.—Contribution to the study of Geissler tubes in a magnetic field, by M. H. Pellat.—The cooling power and conductivity of air, by M. P. Compan. An experimental determination of the velocity of cooling of a blackened copper ball in dry air at different pressures. The velocity of cooling could be expressed by the formula of Dulong and Petit for pressures between 760 mm. and 15 mm.; for pressures below this the rate of cooling falls off much more rapidly than would correspond to this formula.—Observation of an antisolar corona on the Puy de Dôme, by M. Bernard Brunhes.—On a petroleum ether thermometer, by M. L. Baudin. By the use of a light petroleum ether possessing a density of 0·647 at 15° C., a thermometer can be constructed which does not solidify at the temperature of liquid air, and which can be used to measure temperatures down to that point. It was graduated at four fixed points, the boiling points of oxygen, nitrous oxide, methyl chloride and the melting point of ice.—On the dilution constant of saline solutions, by M. Albert Colson.—On metallic strontium and its hydride, by M. Guntz. Strontium can be prepared by the electrolysis of an aqueous solution of strontium chloride with a mercury kathode and then driving off the mercury from the amalgam by very cautious heating. Heated in hydrogen at a moderately high temperature it forms a hydride, fusible at a red heat of the composition SrH_2. The properties of strontium resemble those of barium, except that strontium does not appear to form an ammonium compound with liquid ammonia.—On the plurality of the blue oxides of molybdenum, by M. G. Bailhache.—On methylene chlorobenzoate and dibenzoate, by M. Marcel Descudé. These two compounds are obtained simultaneously by the action of benzoyl chloride upon trioxymethylene in the presence of zinc chloride.—On the hyposulphites of the aromatic amines, by M. A. Wahl.—Some new reactions of the organo-metallic derivatives. Synthesis of ketones, by M. E. E. Blaise. Magnesium organo-derivatives react with nitriles to form compounds immediately decomposable by water with the formation of ketones. The reaction appears to be general, and details are given of the preparation of ethyl-*o*-tolyl ketone, benzyl-*n*-propyl ketone, benzylisoamyl ketone, *o*-methyldesoxybenzoin, *n*-butyl-*p*-tolyl ketone, *n*-propyl-*p*-tolyl ketone, *n*-propylisoamyl ketone, ethyl-propyl ketone and ethyl-phenyl ketone. The semicarbazides of these ketones were also prepared, and their melting points are given.—On the basic properties of oxygen and its quadrivalency in the xanthene series, by M. R. Fosse.—The action of normal propyl and butyl alcohols upon their sodio-derivatives; the synthesis of dipropyl and dibutyl alcohols, by M. Marcel Guerbet.—The study of fermentation amyl alcohol, by M. G. Bemont. Fermentation amyl alcohol boils at 131° and gives on oxidation a valeric acid boiling at 175°, probably methyl-ethylacetic acid.—On the variation of the kidney and its excretion in fowls fed with meat, by M. F. Houssay. Under a meat diet the urea excreted is nearly three times the amount with a grain diet, and the kidney would also appear to increase in weight by about one-third.—A new contribution to the search for the typhoid bacillus, by M. R. Cambier. The author has shown in a previous note that the typhoid bacillus can make its way fairly readily through the walls of a porcelain filter immersed in a nutrient broth. The *Bacillus coli communis*, which is also very mobile, can grow through the walls in a

similar manner. In the present paper an account is given of an attempt to diminish the mobility of the latter bacillus by the addition of alkali and common salt. Particulars are given of an application of these facts to the determination of the presence of the typhoid bacillus in drinking water.—Study of the variations of the organic matter during germination, by M. G. André.—A method for separating glutamic acid and leucine by means of hydrochloric acid gas, by M. A. Étard.—On the bluing of certain fungi, by M. Gabriel Bertrand. On breaking certain fungi of the genus Boletus, the tissue exposed to the air takes on a fine transient blue colour. It is shown that this effect depends on six different factors: the substance boletol, the oxygen of the air, laccase, manganese, water and a metal belonging to the series of the alkalis or alkaline earths.—On the root of Iboga and ibogine, by MM. Lambert and Heckel. A physiological study of the active principle of Iboga. The alkaloid ibogine possesses anæsthetic properties resembling those of cocaine.—An attempt at the measurement of cytological activity, by M. Rémy Saint-Loup.—Observations on the root nodosities in the Leguminosæ, by M. Émil Laurent.—The causes of sterility in peaty soils, by M. J. Dumont.—A new case of variation in the vine following mixed grafting, by M. A. Jurie.—On the aging of the embryo in the Graminaceæ, by M. Edmond Gain.—On the refracting globules of the chlorophyllian parenchyma of leaves, by M. Louis Petit.—Considerations on the sexuality of certain yeasts, by M. A. Guilliermond.—Proof of the existence of the Trias in Greece. The stratigraphical position of the Cheli limestone, by MM. L. Cayeux and Ed. Ardaillon.—Observations on the synclinal of Amélieles-Bains, by MM. Léon Bertrand and O. Mengel. The dislocation in the quartz at Éveaux and at Saint-Maurice (Creuse), by M. L. de Launay.—On a new Miocene layer in the interior of Corsica, by M. E. Maury.—Some new proofs relating to the contamination of the springs in the chalk in France, by M. Martel. The case is considered of streams which flow above ground for some distance and become polluted and then disappear into fissures of the chalk, and after undergoing a certain amount of filtration reappear in the form of springs. Confirmation is given of the possibility of danger from this source.—On the project of crossing the Sahara by balloon, by M. Deburaux.

NEW SOUTH WALES.

Royal Society, November 6, 1901.—Mr. H. C. Russell, C.M.G., F.R.S., president, in the chair.—The following gentlemen were elected hon. members of the Society:—Prof. J. W. Judd, C.B., F.R.S., Prof. Simon Newcomb, and Sir Benjamin Baker, K.C.M.G., F.R.S.—The Clarke memorial medal for 1901 was awarded to Mr. Edward John Eyre, Walreddon Manor, Tavistock, England, for his exploring work.—The Thurrawal language, by Mr. R. H. Mathews. In this paper the author describes the structure of the native speech of the aborigines of the region between Jervis Bay and Port Hacking. An appendix exhibits the elements of some other dialects adjoining the Thurrawal tribes on the north and west, the whole concluding with an extensive vocabulary.—Note on the sesquiterpene of Eucalyptus oils, by Mr. Henry G. Smith. In this paper the author showed that a sesquiterpene occurs in many Eucalyptus oils and that it is this constituent that gives the pink coloration to Eucalyptus oil when testing for eucalyptol with phosphoric acid.—Current papers, No. 6, by Mr. H. C. Russell, C.M.G., F.R.S. In the year November 1900 to November 1901, 130 current papers were received, and these form the basis of the present paper. In this list there was a marked increase on the tracks Sydney to Canada and United States. Previously very little was known of the drift of bottle papers in that sea; but during this year an appreciable increase of interest has been manifested in the current papers found amongst the islands. These show very clearly the presence of a very rapid current near the equator, somewhat similar to that in the Indian Ocean. For instance, current paper 598 made daily a drift near Fiji of 11·1 miles per day; near Gilbert Island, No. 671 travelled at the rate of 19·5 miles per day; and near Phœnix Island the current paper No. 674 travelled 16·8 miles per day; and so on. At first it seemed that current papers aggregate in certain months, but upon the monthly papers which have been received in five years there is not much to support the idea. But there is good reason to believe that the current paper is affected by the wind as well as by the currents, and that strong persistent winds alter the landing places of current papers.

DIARY OF SOCIETIES.

THURSDAY, JANUARY 2.

RÖNTGEN SOCIETY, at 8.30.—On the Function of an Auxiliary Electrode in X-Ray Bulbs: C. E. S. Phillips.—On Radiography applied to Dental Surgery: Prosper H. Marsden.—Mr. H. W. Cox will demonstrate a New Method he has devised for exciting Several Tubes simultaneously from One Coil.

FRIDAY, JANUARY 3.

GEOLOGISTS' ASSOCIATION, at 8.—On the Waves of Sand and Snow: Dr. Vaughan Cornish.

MONDAY, JANUARY 6.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—The Report of the Joint Arsenic Committee of the Society of Chemical Industry and of the Society of Public Analysts will be presented by the Chairman.—The Retarding Influence of Aldehydes on the Maturation of Spirits: Prof. J. T. Hewitt.

VICTORIA INSTITUTE, at 4.30.—Modifications in the idea of God, produced by Modern Thought and Scientific Discovery: Rev. Chancellor J. J. Lias.

WEDNESDAY, JANUARY 8.

SOCIETY OF ARTS, at 5.—Photography and its Applications, II. (Juvenile Lecture): Sir Henry Trueman Wood.

GEOLOGICAL SOCIETY, at 8.—A System of Glacier-Lakes in the Cleveland Hills: P. F. Kendall.—The Glaciation of Teesdale, Weardale and the Tyne Valley, and their Tributary Valleys: A. R. Dwerryhouse.

ROYAL GEOGRAPHICAL SOCIETY, at 4.30.—Waves: Dr. Vaughan Cornish.

THURSDAY, JANUARY 9.

MATHEMATICAL SOCIETY, at 5.30.—Non-uniform Convergence, and the Integration of Series: the President.—Network: S. Roberts, F.R.S.—On Quartic Curves with a Triple Point: A. B. Basset, F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Discussion of the Technical Reports on the Institution Visit to Germany, 1901, by the Committees on Traction, Light and Power; Manufacturing, and Telegraphs and Telephones.

FRIDAY, JANUARY 10.

ROYAL ASTRONOMICAL SOCIETY, at 8.

MALACOLOGICAL SOCIETY, at 8.

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