THURSDAY, NOVEMBER 17, 1904.

THE THEORY OF CONTINUOUS GROUPS.

Introductory Treatise on Lie's Theory of Finite Continuous Transformation Groups. By John Edward Campbell, M.A., Fellow and Tutor of Hertford College, Oxford, and Mathematical Lecturer at University College, Oxford. Pp. xx+416. (Oxford: Clarendon Press, 1903.) Price 14*s.* net.

THE theory of continuous groups should appeal to all who are interested in mathematics; it is based on the fundamental ideas involved in cases of change of the algebraic notation, and as such is an illuminating synthesis of a large number of our elementary operations; and the principal notions of the theory, once laid bare, are so simple and admit of so many familiar applications that these should form an integral part of elementary teaching, particularly in analytical geometry and differential equations. As to its philosophical import, the theory is of the greatest value in the analysis of our geometrical conceptions, being an indispensable part of that algebraic scheme which, at present running parallel with these, may modify them still more than hitherto before the parallelism is recognised again as an identity.

Lie himself, though directing attention to the fact that he heard as a student, in 1863, lectures from Sylow on Galois's theory of discontinuous groups, and acknowledging his indebtedness to several writers on partial differential equations, would seem to have been interested, above all other things, in the transformations of analytical geometry; and while the precise propositions of his theory of groups must be primarily attributed to his study of systems of linear partial differential equations, his bias was at first, and largely throughout, to arrive at his conclusions by the help of geometrical intuition. Thus, though he has succeeded so extraordinarily in what he tells us was one of his objects, drawing again into organic union branches of mathematics which threatened to pursue solitary developments, there is, some may think, a certain underlying vagueness of definition as to the character of the functions to which his theories apply. This even has, perhaps, some advantages.

Of these various points of view the book now under notice gives the English student an excellent means of judging. With roughly the same purpose as the simplified German account of Lie's theory (Scheffers, 1893, 800 pages), it is briefer, and yet quite clear in statement; it contains more of the application of Lie's theory to the solution of partial differential equations, and it offers alternative proofs, due to its writer, of the fundamental theorems of the subject. Like the German book, it largely leaves aside the developments subsequent to Lie, such as the intricate theory of the structure of groups, and the application to the transformation group of systems of differential equations initiated by Picard, and leaves wholly aside Lie's criticism of the axioms of geometry, while it accepts Lie's function theory throughout; but it abounds in apt examples, chosen mainly from differential equations and geometry, so that almost any mathematical student may find something to interest him, and, with such limitations as noticed above, it is extraordinarily full and complete. Altogether a book which should be widely read.

So much so that it is both difficult and uncongenial to offer any criticisms, were only a review complete without some. To us it seems that some account of *systems* of equations which in the aggregate define a finite continuous group forms the most natural introduction to the theory; though Lie's account of them comes near the end of his third volume he is there revising his fundamental principles, and the ideas involved are very simple. Reference to Schlesinger's "Treatise on Linear Differential Equations" (Bd. ii., Teil i., p. 23) shows how this suggestion works out in detail. It seems right that the student should early learn, for instance, how far the linear transformations which leave x^2+y^2 unaltered fall under Lie's terminology. Perhaps, again, fuller references to anticipations of the ideas which Lie has coordinated into one system would have helped the student. Such may be found widely scattered in all the early masters; two that are handy to us are in Sylvester's writings. In 1852, when Lie was ten years old, Sylvester ("Collected Works," vol. i., pp. 326, 353), while ascribing the notion partly to others, writes of *continuous* or *infinitesimal* variation, and that "concomitance cannot exist for infinitesimal variations without, by necessary implication, existing for finite variations also." Or, again, the deduction, so interesting when we first came across it, of the equations for the infinitesimal motion of a rigid body, from the invariance of the expression $dx^2+dy^2+dz^2$, is in a paper of Sylvester's of 1839 (*ib.*, p. 34). Again, it appears to us, though recognising the value of Mr. Campbell's proofs of the fundamental theorems, that much would have been gained in directness, without appreciable increase of the necessarily analytical character of much of the subject, by a frank recognition of Schur's forms for the first parameter group in terms of the constants of structure; of this we are, perhaps, not impartial judges (see *Proc.* Lond. Math. Soc., vol. xxxiv. p. 91), as equally not of Mr. Campbell's use of the word *united* in his exposition of Lie's definition of an integral of a partial differential equation, having ventured elsewhere to introduce the words *connected* and *connectivity*, which latter seems better than the mere symbol M_n which Mr. Campbell adopts from Lie (see "Encyc. Brit.," vol. xxvii. p. 452). But we have a more serious contention with Mr. Campbell about a matter in which opinions will be widely divided; no doubt it is proper that a beginner's course in the theory of groups should insist primarily on the group property, and not confuse this by complicated considerations in regard to the properties of functions; but in our opinion no account can be regarded as modern which does not face the difficulties; it seems to us misleading, without careful explanations, to use language about functions in general which applies in the first instance only to the simplest algebraic functions. On p. 11 we read: "b_k can in general be expressed .. . . in order that (2) may remain an analytic function of its arguments." In what way is the student to imagine the function defined after it has ceased to be

an analytic function of its arguments? or does the word *analytic* mean *regular*? and what is the meaning of *expressed*? Again, on p. 98: "This transformation of the variables has only involved algebraic processes." The processes in question consist in reverting certain power series; now a power series is an entirely symbolic thing unless we have very simple rules for the law of its coefficients; how can the reversion of a power series in general be regarded as a practicable process likely to aid the effective determination of the integrals of a differential equation? and at any rate it does not seem fair to describe it as an algebraic process. Moreover, apart from such indefiniteness, and passing over such phrases as (p. 24) "where t is a constant so small that its square may be neglected," there is the question, apparently unconsidered in this book, of how far Lie's propositions can be proved for functions which are not analytic, in regard to which various investigations are already forthcoming.

But we gladly turn from such criticisms to remark again on the merits of the book, choosing two random examples, one of the practical spirit in which it is written, the other of the author's eye for a neat result. On p. 256 the author frankly uses the known theorems as to forces in three dimensions to abbreviate the reduction of the equation of a linear complex. On p. 243 the author arrives at the theorem that Ampère's partial differential equation of the second order is reducible by a contact transformation either to $s=0$ or to $rt-s^2=0$, according as it possesses two distinct systems of intermediary integrals or only two coincident systems. In conclusion, we would express our admiration for the form and printing of the volume.

H. F. B.

TECHNOLOGICAL CHEMISTRY.

The Industrial and Artistic Technology of Paint and Varnish. By A. H. Sabin, M.S. Pp. vi+372. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1904.) Price 12*s.* 6*d.* net.

Food Inspection and Analysis. By Albert E. Leach, S.B., Analyst of the Massachusetts State Board of Health. Pp. xiv+787. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1904.) Price 31*s.* 6*d.* net.

(1) THIS is a gossipy, pleasantly discursive volume, the style of which will be indicated when we remark that the book is prefaced by an extract from Quintilian, and closes with a poetical quotation. It treats, generally in untechnical and even colloquial language, of varnishes and paints, their history, fabrication, and uses. Principles, not formulæ, are usually given by the author; the book is in no sense a collection of recipes.

If there is not much of strictly scientific value in the treatise, there is a good deal which is of practical interest. The chapter upon the protection of metals against corrosion, for instance, may be recommended to the notice of engineers, and also that on the coating of water-pipes. As regards this latter question, the author points out that the essential feature of the "Angus Smith process" has been misapprehended in modern practice. Dr. Smith's treatment resulted in a varnish or "enamel" of linseed oil and coal-tar pitch being baked on to the cleaned surface of the pipe, the oil oxidising more or less completely during the operation. The modern substitute for this is, too often, a mere dipping of the pipe in crude tar, or in tar diluted with "dead oil." From the wording of the original patent this process may, on a technicality, pass under Angus Smith's name; but our author has no doubt that if the inventor were living he would condemn the whole thing from beginning to end. It is "adulterating his invention and stealing his reputation."

Mr. Sabin describes a process of his own, which has, he tells us, been successfully applied to large pipe-lines in America, and is in use in the United States Navy for the protection of heavy copper mains. It is evidently based upon a study of the Angus Smith process. It consists in applying to the pipes a thin coating of a mixture of linseed oil and asphaltum, and afterwards heating the pipe to 400° F. until the oil is completely oxidised. The product is said to be a hard, elastic enamel. One result is that, whereas the aforesaid copper mains had formerly an average "life" of about six months, they have now lasted three or four years, and their ultimate durability is not yet determined.

There is some curious lore in the author's historical summary. The connection between electricity and "Berenice with the golden hair," between varnish and the Queen of Cyrene, is a good example of etymological ramifications. One quaint recipe of 1520 is worth quoting:—

"A most excellent varnish for varnishing arquebuses, crossbows, and iron armour: Take of linseed oil two pounds, sandarac one pound, Greek pitch two ounces. Boil the oil, then dissolve in it the other ingredients, and strain through a much-worn linen cloth; and when you wish to use the varnish, scrape and polish the work and heat it in a hot oven, because that is the best place to heat it . . . then lay it on thinly with an instrument of wood, so that you may not burn your fingers, and it will make a beautiful changing colour.

"And if you supplied the place of Greek pitch with naval pitch, I think it would make the work black when you varnished it."

The treatise can be read with profit either by the manufacturer who knows little of chemistry, or by the chemist who wishes to know something of paint and varnish technology.

(2) There is a Madras story of a native woman, who, charged with possessing illicit salt, would offer no defence; wherefore she was about to be mulcted in the sum of one rupee. Before closing the case, however, the magistrate thought he might just as well satisfy himself that the substance really was salt, and forthwith proceeded to taste it. Thereupon the lady raised her voice in a very effective interjection: "Not only," said she, "not only does the sahib fine me one rupee, but lo! he eats the ashes of my dead husband."

Fortunately for magistrates, such appeals to the palate are rarely either necessary or sufficient, nowadays, for disposing of legal cases relating to the identity and purity of foodstuffs. Much more cum-

brous machinery has had to be devised. To summarise and explain this machinery is the aim of the work under notice. In the main it is intended for the food analyst, and the author's idea has been to give this official some information, not only on the subject of food-analysis, but also on various collateral matters with which he is brought into contact. Thus there are sections discussing the equipment of the laboratory, the storage of samples, legal precautions, the duties of the food inspector, and certain processes of food manufacture.

All the ordinary foodstuffs are dealt with, a chapter being allotted to each group of allied products, such as cereals, spices, alcoholic beverages, and so on. The descriptions are written clearly; an excellent selection of the salient facts and the best methods of examination has been made; and to each division an extensive bibliography is appended. Microscope work is a special feature, and the volume is enriched by a series of forty plates, containing about four times as many photomicrographs of the principal vegetable and animal structures met with in the examination of foods.

The chief criticism to offer on the book is that the treatment of so much material in one volume—even one of eight hundred pages—must necessarily be in the nature of a summary. Hence in many instances the information, though sufficient for routine work, is not full enough to be of much value when cases of real difficulty arise.

One notes several examples of careless transcription in looking through the work. On p. 441 the so-called "Koettstorfer's equivalent" for butter-fat is given a maximum value of 241 and a minimum of 253. It might be guessed that these two numbers have been transposed; but on the next page the value of the constant in question is given as 224. The author has, in fact, failed to distinguish between the "equivalent" and the "value" of the saponification experiment. In the table on p. 441 the values of the insoluble acids for oleomargarine are transposed; the specific gravity has no temperature of reference; and a faulty arrangement of the table makes it appear that butter-fat and margarine possess, somehow, a maximum and a minimum temperature; whilst in the data for edible oils and fats on p. 380 the limiting values are again transposed.

Nevertheless, it would be unfair to judge the book by these slips. It contains a large amount of information and, though written more particularly from the American point of view, will be found a useful conspectus of the whole field of food control.

C. SIMMONDS.

THE TRANSPIRATION OF PLANTS.

Die Transpiration der Pflanzen. Eine Physiologische Monographie von Dr. Alfred Burgerstein, A. O. Universitätsprofessor in Wien. Pp. x+283. (Jena: Gustav Fischer, 1904.) Price 7.50 marks.

THIS book is a classified analysis of the published work on transpiration from the time of Hales onward, with a running criticism by the author, who is well known to have attended to the subject for many years.

The amount of contradictory evidence is remarkable. In the case of the earlier experimenters, with more or less faulty methods, this is not surprising; but the same thing strikes one in many modern instances. The question of the amount of transpiration in moist tropical regions, as compared with Europe, is a case in point. Another instance is what the author describes as a "seven years' war" (1884–1891) between Wille and Lundström as to the absorption of water by the aërial parts of plants. Other disputed points are the effect of salt solutions supplied to the transpiring plants, and the influence of varying amounts of CO_2 in the atmosphere; and many other cases might be cited.

The relation of plants to water, though a subject of primary importance, is still to a great extent in the elementary stage of inquiry. A large number of the statements quoted by Burgerstein are little more than disconnected facts, and, in spite of the interesting book he has made of them, they still seem to us to await a somewhat different treatment.

The subject-matter of the book falls into two classes:—(1) the loss of water-vapour considered as physical phenomenon; (2) the biological inquiry into the adaptation of plants to the distribution of water considered as environment. From both points of view transpiration should be considered side by side with assimilation and respiration, and this manner of looking at the subject has not, in our judgment, been kept sufficiently in mind by the author. The point is that the same organs—the stomata—serve for gaseous exchange and for the evaporation of water. Burgerstein discusses at the end of his book the question whether, as some have supposed, transpiration is a necessary evil. This might have been discussed from a broader standpoint, and would have been in place in an earlier chapter. It does not seem necessary to treat the view referred to as entirely false. Plants undoubtedly have to strike a balance between the possession of a free stomatal connection with the atmosphere and the consequent danger of evaporating more water than they can take up from the soil. This compromise includes also the value of the transpiration-stream in supplying minerals to the aërial parts, on which Burgerstein rightly lays stress. All we suggest is that the whole problem, being of a fundamental character, might well have been dealt with more liberally, and been given a place preliminary to the details of transpiration.

A fault in Burgerstein's treatment of transpiration, though a fault difficult to avoid, is that he does not keep before the reader the fact that the condition of the stomata—whether open, half open, or shut—is far and away more important than all the other internal conditions put together. Like the rest of the world, he is well aware of this, but we doubt whether the uninstructed reader would here learn to think of the problem in this way. To take an example, he describes (p. 62) how, when part of the foliage is removed, the remaining leaves transpire more actively than before. Here we want a discussion of the possible effects, direct or indirect, of the operation on the

stomata of the remaining leaves. The same thing is true of the discussion (p. 81) on the transpiration of flowers as compared with leaves, where the reader is left in ignorance of how far the facts are explicable by reference to the stomata.

But it is not merely in relation to isolated problems that we feel the want of more information with regard to the stomata. We should expect to find a full general discussion of their importance in regard to transpiration. This would have included a reference to Horace Brown's work on the static diffusion of gas through these openings, and a consideration of the question how far evaporation can be checked by the closure of the stomata. Again, we should have liked a discussion of the trustworthiness and general value of the microscopic measurements of the stomata in living plants. Burgerstein gives an interesting account of the methods depending on the yield of water-vapour, such as Stahl's cobalt test, &c., by which it can be roughly determined that the stomata are "widely open" or "nearly shut." But if we are to distinguish the stomatal factor from other factors in experiments on transpiration, numerical statements as to the condition of the stomata are wanted, and the question whether such data are available might well have been discussed. With regard to method, Burgerstein seems to us a little hard on the various "potometer" methods, by which a general idea of the transpiration curve is obtained by measuring the intake of water. He is justified in saying that these methods do not estimate transpiration but absorption; but we think he undervalues the fact that, with cut branches and for not too extended periods of time, the intake so closely corresponds to transpiration that the method cannot be neglected, and is certainly of great value for purposes of demonstration.

Though we have criticised "Die Transpiration der Pflanzen," we are far from meaning to condemn it; we have, indeed, read it with interest and profit. Anyone intending to make a study of the subject cannot do better than read it with care. He will thus be made aware of many pitfalls, and will have a guide to the chief points which need fresh investigation.

F. D.

OUR BOOK SHELF.

House, Garden, and Field; a Collection of Short Nature Studies. By L. C. Miall. Pp. x+316; illustrated. (London: E. Arnold, 1904.) Price 6*s*.

THIS admirable little work appears to be by far the best aid to the proper teaching of nature-study that has hitherto come under our notice, the author having very wisely refrained from furnishing the teacher with a manual which would do away with all necessity for original study and observation on his part, and enable him to read the various lessons to his pupils without effort or thought. The object of the writer is, indeed, as much to educate the teacher as to enable the latter to teach his pupils. For example, in the article on bananas, Prof. Miall, when he asks the reason for the peculiar shape of that popular fruit, under the guise of leaving the reply to the pupil is really testing the powers of observation and reasoning possessed by the teacher himself.

As the author observes in his introduction, teachers seem to expect a series of ready-made lessons on a variety of nature subjects, basing their demand on the ground that they have no time (or is it that they have no inclination?) to make the necessary studies for themselves. If this course were adopted, it would lead to two evils. First, all the observations (if they could be so called) would come from the teacher and not from the pupils; and, secondly, knowledge thus acquired by the teacher could not possibly raise the delights of genuine nature-study in the minds of his scholars. Prof. Miall has therefore preferred to make an effort to instil and encourage the habit of observation and inquiry in a few teachers (who will necessarily be the best of their kind) by showing them what may be learnt by careful observation of the common natural objects to be met with among their daily surroundings, rather than by pandering to the popular clamour for cut and dried lessons—which are really not nature-study at all. How he has succeeded remains to be seen. If we may venture to predict, it will be the clever and inquiring teachers who will praise and take advantage of his efforts, and the dullards and plodders who will condemn them and say that they are unsuited to their purpose.

Although the author modestly says that he gives only a few lessons, his articles or essays are no less than fifty-four in number, and cover a very wide range of subjects, including cheese-grubs, glow-worms, water-lilies, London pride, the human face and hand, and museums and their teachings. As an example of the large amount of information Prof. Miall manages to give in a very small compass, we may refer to the exceedingly interesting account of the ancestry and evolution of insects in the chapter on the "cheese-hopper." An excellent work which should be in the hands of all teachers is our verdict. R. L.

Ideals of Science and Faith. Essays by Various Authors, edited by the Rev. J. E. Hand. Pp. xix+333. (London: George Allen, 1904.) Price 5*s*. net.

"ON all sides" (to quote the preface) "is a growing recognition that the ideals common to both Religion and Science are not only numerous but are indeed the very ideals for which the nobler spirits on both sides care most." Necessarily the treatment is varied, perhaps too varied, but the editor gently deprecates criticism of this feature. Prof. Patrick Geddes has room to discourse on the excellence of teaching boys to make boxes; and the theologians, under "A Presbyterian Approach," "A Church of England Approach," and the like, hardly give one a definite view of "A Christian Approach."

In the papers of the men of science and philosophers the general position is that science does not deal with the whole of life, and that it can no longer meet the claims of faith with a "*certainly not.*" Sir Oliver Lodge defends the idea of continuous guidance on the part of the Deity, seeks to reconcile Pantheism and the belief in a personal God, and complains that religious people seem to be losing some of their faith in prayer. Prof. J. Arthur Thomson and Prof. Patrick Geddes lay stress on the altruistic side of the struggle for existence. Prof. Muirhead maintains that we must limit causation and the conservation of energy to the material world, and must look for some other conception when we come to the action of the mind itself. "We use a saw to make a fiddle; we throw it (*sic*) aside when we come to play upon it (*sic*)." The Hon. Bertrand Russell's paper—"An Ethical Approach"—is the most eloquent; much of it is Lucretius, Book iii., rewritten (could one be more complimentary?), with the difference that Mr. Russell recognises more definitely the need for religion and worship, albeit the worship of a God who is not Force but "created by our own love of the good."

Die orientalische Christenheit der Mittelmeerländer. By Dr. Karl Beth. Pp. xvi+427. (Berlin: Schwetschke, 1902.)

THE author spent five months in 1901 in the eastern Mediterranean, investigating at first hand, and at close quarters, the institutions, and the practical working of the Greek, Armenian, and Coptic Churches, and of such other fragments of Christian communions as survive in those parts. He is evidently a good observer and quick worker, and was able to elicit much interesting information, meeting everywhere, as he did, with cordial receptions and assistance. The result is a valuable handbook of an ill-explored section of ecclesiology, full of queer side-lights upon mediæval and modern history, and no less upon the workings of the religious instinct under the peculiarly unfavourable conditions which have prevailed in the Levant for so long. The author's personal knowledge of the working of these curious institutions enables him to supply a number of corrections to Kattenbusch's "Lehrbuch," and to confirm and expand the observations of Gelzer, von der Goltz, von Soden, and other recent travellers.

Tales of Sutton Town and Chase, with other Tales and some Sketches. Collected by "Tau." Pp. 86. (Birmingham: Hudson and Son, 1904.) Price 2*s.* 6*d.* net.

TWO of the narrative poems in this delightful little collection are of more than local interest. One ballad —"The Alchemist of New Hall"—refers to the moated stone mansion of New Hall, where the celebrated Dr. Sacheverell lived at one time. Another poem deals amusingly with a meeting of the Lunar Society, which met in the district in the latter portion of the eighteenth century, and included among its members Erasmus Darwin, Galton, James Watt, Priestley, Wedgwood and Baskerville. To persons familiar with Sutton Coldfield and the neighbourhood, this collection of verses describing in appropriate words and metre some of the stories of "oldest inhabitants" will be read with keen interest; and many others will find pleasure in the quaint ideas contained in this dainty little volume.

The Glamour of the Earth. By George A. B. Dewar. Pp. ix+255; with illustrations by R. W. A. Rouse. (London: George Allen, 1904.) Price 6*s.* net.

THE true lover of the country will enjoy this book. The author is not addressing the mere seeker after information; and such a reader will regard the volume as diffuse and unsatisfactory. But men who are weary with work and have gone to the country quietly to come into contact with nature, and so secure refreshment and recreation, will follow Mr. Dewar's notes and leisurely observations with sympathy and appreciation. The beautiful pictures by Mr. Rouse add much to the attractiveness of the volume.

Jahrbuch der Radioaktivität und Elektronik. Herausgegeben von J. Stark in Göttingen. Erster Band. 1 Heft. (Leipzig: S. Hirzel, 1904.)

THIS new magazine or "year-book," devoted to radio-activity and the electric discharge, is promised to appear in four parts yearly. The first part, now under consideration, contains two original contributions, six short summaries of recent work on special branches, and a fairly complete list of the original papers on radio-activity, &c., which had appeared in 1904 up to the date of going to press. The short summaries referred to are preceded by bibliographies, and should prove useful to specialists.

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.*]

What is Brandy?

WITH regard to the interesting article in your issue of November 3 upon this subject, I trust that I may be allowed to pass a few comments.

There can be no doubt that the word "brandy" originally connoted burnt or distilled wine; its derivation is thus stated in the "Oxford Dictionary" of Dr. Murray as from the Dutch word "brandewijn," old English "brandy wine."

Thus so late as 1719 one D'Urfey, "Pills," v. 23, wrote:—

"I was entertained, with Kisses fine and Brandy wine."

Certain spirits were introduced long before the outbreak of the phylloxera in France under the name of British brandy, still included in certain legal documents under the designation of British compounds, though, as a matter of fact, made more without than within this country. Herein a difficulty arises for those who may have to advise county or borough councils in the administration of the Sale of Foods and Drugs (Amendment) Act, as now interpreted, or those, like myself, who have to deal with cases under the Merchandise Marks Act. For on the one hand an astute chemist could make up a liquid, wholly innocent of grape juice, so that the results, obtained on analysis, were identical with those of a genuine grape-spirit, and on the other, a sample of the latter might, as pointed out in your article, if carelessly distilled be condemned, though innocent.

Again, if a genuine grape spirit, distilled not far from Cognac, were mixed with — per cent. of a spirit, not silent (I omit particular details on the ground of expediency), mere analytical results would be of little avail; such a problem (*credite experto*) requires prolonged research, and the application of methods not wholly chemical.

It is clear that professional tasting, especially by certain specially gifted persons, is a very valuable aid to analytical results and methods of research, yet, as a matter of evidence, it can be regarded only as a question of opinion, based on long experience, rather than as a definite proof.

A Government inquiry would elicit important evidence, and possibly some kind of standard might be arrived at which would not only exclude clever and fraudulent imitations, but also bring the present chaos or *impasse* to a conclusion.

V. H. VELEY.

Oxford, November 5.

YOUR article published under the above heading in NATURE of November 3 raises some interesting points. The writer clearly fails to appreciate any difference between brandy and alcohol, for he says, "if the brandy is being made from damaged wine the rectification must be most carefully conducted, and may have to be pushed to a point that the alcohol is obtained almost pure, that is to say, almost free from *non-alcohol*." Now if brandy is merely alcohol, as is here plainly implied, why produce it from grapes or wine at all? Similarly, why produce whisky from malted barley, or rum from cane sugar? The fact is that the genuine article is, and has always been in history, the product of the pot still. The pot still produces alcohol plus "*non-alcohol*," the patent still pure alcohol. It is true that brandy, whisky, and rum contain alcohol, but the alcohol of the patent still or rectifying still is not whisky, brandy, or rum. Pot still spirit from "damaged" or sick wines would be nauseous and undrinkable, but pot still spirit from wines of repute possesses the qualities which distinguish genuine brandy chemically and physiologically from rectified spirit. It is well known that the effects of pure alcohol on the blood pressure and lymph circulation are modified very considerably by the presence of other constituents in spirits. These other constituents are the "*non-alcohol*" which you describe. To call rectified spirit or patent still spirit brandy is about as reasonable as calling skimmed milk milk. In England the word brandy ought to be confined to a pot still spirit produced from the wine of grapes, and should never be applied to alcohol distilled in a patent still from "damaged wine" or from likely

enough worse material. Such a definition, if adopted, would be "calculated to facilitate the work of the unfortunate public analysts who may be called upon to express an opinion as to the genuineness of a sample of brandy," and the question, what is brandy? analytically speaking, would no longer "await solution." Recent analyses to which you refer have at any rate reduced a large section of the brandy trade to the confession that much of the stuff they sold never had its origin in the grape at all. The public house trade now posts notices in the bars that it cannot guarantee the brandy sold to be genuine grape spirit.

The attitude of the French committee is not difficult to understand, and there can be no objection to it so long as the trade, in the interests of which it has undertaken the inquiry, determines on issuing an honest label setting forth that either the spirit is a pot still spirit from grape wine or it is not. S. ARCH. VASEY.

Bromley, Kent, November 8.

The Origin of Life.

ALTHOUGH there are good reasons for believing that the life of our world is the product of its own physical conditions, and distinct from the life of other members of the solar system, it is hardly probable that living substance can be produced otherwise than by the same conditions that produced it in the past, and one of these conditions is a vast period of time.

We are not acquainted with any life apart from "cells." But the cell is a very complex organism, and between inorganic substance and the cell there may have been as long a course of evolution as between the cell and the highest existing animal or vegetable. Probably most biologists nowadays regard life not as an entity (*e.g.* not as a "vital force"), but rather as a coordination of many physical processes which have become more numerous and better coordinated in the course of evolution. It is not to be supposed that the *total* functions of life would be developed in not-living substances under the restricted conditions of human experiment; nevertheless, some of the *individual* functions might be brought into action, at least in a primitive form.

One of these functions, which I believe to be the most fundamental, is the deoxidation of a compound containing the elements N, O, C, H, &c., by the action of light, moderate heat, or slight electrical disturbance. This is the foundation of biosynthesis—a small beginning which in the course of ages develops mechanisms so perfect as the photosynthesis in chlorophyll-bearing cells. We ought by research to discover the conditions on which such deoxidation depends, and imitate it in our laboratories; we might even apply it to important economic purposes.

This deoxidation is probably a perfectly natural process, as natural as the opposite process of oxidation, only it must not be sought in the behaviour of mere oxides, as CO_2, but rather in that of compounds containing N, O, C, H, &c., as above suggested. In fact, it may be expected to be nearly a reversal of the process of vital oxidation, which has been more successfully investigated. Vital oxidation seems to take place in two stages, as follows:—(1) the O is taken into combination with the N in a complex molecule, (2) it is transferred from the N to a more oxidisable element. Whether complete linking occurs between O and N, as O=N≡, we cannot say; but the linkings ≡C—O—N≡ and H—O—N≡ are probable. The oxygen-carrying function of N seems to be assisted in many (if not all) cases by Fe.

First attempts at life may be occurring continually around us, but if any synthetic substances be formed they are sure to be seized and assimilated by the already developed organisms. F. J. ALLEN.

Cambridge, November 12.

Change in the Colour of Moss Agates.

IN connection with Mr. Whitton's inquiry (NATURE, November 10, p. 31), the following note may be of interest.

On the top of the West Cliff at Bournemouth the road is laid with material which includes a number of flint pebbles. These are, as a rule, rounded or subangular, and of a yellow or whitish-yellow colour as regards their general surface. But where exposed to the air the colour has changed to deep blue, violet, or purple, and so much so that in places the whole surface of the road has a marked blue shimmer. Or perhaps it should rather be said that this was the case last autumn; I have not seen it since.

As will be seen from the enclosed specimen, the contrast between the imbedded and the exposed portion of the pebbles is very striking.

Without giving any special study to the matter, I was inclined at the time to attribute the phenomenon either to a further oxidation and hydration of the iron which is, no doubt, present in the flints, or, possibly, to a molecular rearrangement of the silica. At some points the blue colour passes almost into black; this suggests that it may indicate a transition stage between yellow and black flints.

Possibly some mineralogist has examined the matter more thoroughly. C. SIMMONDS.

Northcroft, Deronda Road, Herne Hill, November 14.

Chemical Analysis for Beginners.

IN a review on this subject (this vol., p. 5) "J. B. C." directs attention once again to the unsuitability of an extended study of analysis for a beginner. His opinions not only claim respect, but must be largely shared by all teachers of chemistry.

There is, however, a side to the question which somehow seems rather to be overlooked. The average elementary student will work patiently for hours over qualitative analysis, well taught, badly taught, or not taught at all—he is interested, and though none too willing to use brains as well as tables, he is ready under guidance to do his best. But in any logical system of elementary quantitative and preparation work calculated to build up a firm foundation in the principles of chemistry he appears to take no *natural* interest, when it comes to actual work. Possibly "J. B. C." will not agree that this is so; and it may be right that the student should be compelled (if it can be done) to think logically from the first. But it seems not unimportant to interest him in practice as well as "on paper."

I do not refer to the embryo professional chemist who soon gets through the introductory work and is nearly always interested, but to that enormous crowd of text-book consumers who spend, possibly, three hours per week in the chemical laboratory as part of their scheme of study. Does not the marked change of attitude in such students when qualitative analysis is touched upon indicate that there is still room for fundamental improvement in the method of presenting first steps in practical chemistry?

F. SOUTHERDEN.

Royal Albert Memorial College, Exeter.

Misuse of Words and Phrases.

IN Mr. Basset's book, to which he refers in NATURE of November 10 (p. 30), he speaks of the advantage of having "a concise and pointed mode of expression, which saves a great deal of circumlocution and verbosity." He thinks that this object is best gained by coining a new word from the Greek, for instance, *autotomic*, whereas I hold that the same object is better gained by adopting a word of English derivation, *self-cutting*. Mr. Basset now says that he considers this word "inelegant," and, in the absence of any standard of elegance, I can only reply that this is a matter of individual taste. Perhaps it would be better still to call a curve that has double points a "nodal curve," and one that has none a "nodeless curve." The word *binodal* is already in use.

As regards the phrase "non-singular cubic," it is clearly inaccurate if, with Plücker, we speak of "singular lines" as well as "singular points," and include all these under the term singularities; but I rather think that in English books the term singularity was formerly not applied to double tangents, or even to points of inflection.

November 14. T. B. S.

Reason in Dogs.

APROPOS of "thinking cats," perhaps the following story of a practical joke played by a dog will interest your readers.

A friend of mine, Mr. W., owns a Manchester terrier of which he is very fond, and for that reason receives rather more than doggy attention. The dog passes most of his time in the library, where a basket and rug are provided for him, but he prefers, when it is possible, to take possession

of his master's easy chair. A short time ago I had occasion to call on Mr. W., and the dog was, as usual, occupying the chair, from which he was removed to his basket. He showed his resentment of this disturbance of his slumbers by becoming very restless. Presently he trotted over to the door, which he rattled by pushing with his nose, his usual method of attracting attention when he wished to go out. His master immediately rose and opened the door, but instead of the dog going out he rushed back and jumped into the chair his master had just vacated! The rapid wagging of his tail and the expression on his face showed the dog to be very pleased with the result of his ruse. The dog has repeated the same joke once or twice since, with much evident delight to himself. ARTHUR J. HAWKES.

Bournemouth.

Occurrence of a Tropical Form of Stick-Insect in Devonshire.

A FEW weeks ago I obtained through the kindness of a lady in Paignton a living specimen of a stick-insect, one of several individuals which had appeared in her garden. My example was met with on the plaster outside a window, and owing to the tenacity with which it adhered to its position required some force to dislodge it. I preserved it in captivity for about a fortnight, at the close of which period it died, having refused to feed on the foliage of any of the plants with which it was supplied.

It is an apterous female, and is, I think, referable to *Cladoxerus phyllinus*, Gray. I have not been able to obtain any clue as to the cause of its occurrence.

ROBERT O. CUNNINGHAM.

A Probable Variable of the Algol Type.

ON the evening of October 29, while examining the Pleiades with a binocular at about 9 p.m., G.M.T., I noticed that the star Atlas (27 Tauri) was slightly *fainter* than Pleione (28 Tauri), a little to the north of it. I did not remember at the time what the relative brightness of the stars was, and on looking them up in the Harvard Catalogues I was surprised to find that Atlas was measured 3·80 magnitude, and Pleione 5·19. I find that all the estimates for the last 300 years agree in making Atlas considerably brighter than Pleione. The nights following October 29 were cloudy, but on the evening of November 9 I found Atlas of its usual brilliancy, and more than 1 magnitude brighter than Pleione. The observed variation was therefore about 1½ magnitude. As Atlas is not a long period variable, it seems probable that it is a variable of the Algol type. The star should be watched, and observations for variable radial velocity would be very desirable.

J. E. GORE.

THE PREVIOUS EXAMINATION AT CAMBRIDGE.

THE first report of the studies and examinations syndicate, issued on November 11, deals with the previous examination. This is the first public test imposed on candidates for degrees at the university, and since 1822 has included a compulsory examination in both Latin and Greek. In response to a demand for reform sent up by teachers, parents, professional men, and men of science in the direction of making Greek, at least for some students, an optional subject—a demand supported by a large majority of head-masters and assistant masters in the secondary schools—the syndicate proposes a new scheme for the examination in which this demand is recognised.

Briefly, the scheme provides that for *all* candidates the "previous" shall consist of three parts, to be taken together or separately at the convenience of the student. Part i. includes Latin, Greek, French, and German, the papers in each to require unprepared translation and composition. "Set books" are abolished. A candidate may take Latin *and* Greek, or either Latin *or* Greek together with French or German. In other words, he must take *two* languages, of which one at least is an ancient classical language. Part ii. includes arithmetic, algebra, and geometry as heretofore. The paper on "Paley's Evidences" is abolished; it is not a school subject, and it is got up largely by an effort of memory from a bare abstract or analysis. Part iii. includes English composition as a compulsory subject, and two of the following alternatives: (1) English history; (2) scripture knowledge (a Gospel and Acts in English); (3) elementary organic chemistry; (4) experimental mechanics and other parts of elementary physics. Natural science, in the shape of physics and chemistry, is thus introduced for the first time. The syndicate was urged by weighty authorities to require from all candidates some knowledge of science; but, after full consideration, it is unable to recommend more than the inclusion of science among the alternative subjects. Probably, in view of the imperfect organisation of science teaching in many public schools of the classical type, to make science compulsory at this stage would have involved the adoption of a standard so low as in effect to discredit the subject.

For the benefit of certain students, among whom students of science may certainly be reckoned, to whom the power to read French and German is more important than a special knowledge of one only of these, it is provided that the translation papers in each of the two languages may be substituted for the translation and composition papers in one alone.

For a boy from a modern school or technical institute, therefore, the examination provided might thus include, for example, Latin, French, and German translation, mathematics, English composition, elementary chemistry, and elementary physics. On the other hand, a boy from a purely classical school might take the following combination: Latin and Greek, mathematics, English composition, scripture, and English history. For him the examination would be an improvement on the old "previous" examination, not only by reason of the higher standard proposed to be required, but also on account of the wider range of literary subjects to be included.

The report represents a serious attempt to recognise and to provide for the changes which are in progress in modern English education. By asking from every aspirant evidence that he has seriously studied *one*, at least, of the classical languages, it safeguards the traditional virtue ascribed to that form of intellectual training. By admitting that modern languages (including English) and physical science are possible components of a liberal education in the twentieth century, it indicates a certain widening of academic aims and ideals that may lead to better things hereafter. There is little doubt that the report will meet with strenuous opposition from those who, in the supposed interest of ancient learning, dare not make any concession to modern knowledge. It will not escape criticism from reformers of the more advanced type, who would sweep away Latin as well as Greek. But the proposals at least remedy a genuine grievance in a practical manner, and they make for progress along the lines of a sounder and broader education than the older universities have yet sought to foster.

THE EXPLORATION OF THE TRANSVAAL.[1]

IN this first report, drawn up by Mr. H. Kynaston and his colleagues, we see the prospect of healthy rivalry between the geologists of Cape Colony and of the newly acquired territories to the north. No time has been lost in issuing one of those small folio

[1] "Geological Survey of the Transvaal. Report for the Year 1903." Pp. ii+48; with 24 plates, folding maps, and sections. (Pretoria: Printed at the Government Printing Office, 1904.)

volumes, the form of which, however unsuited to our bookshelves, probably recalls to the Government printers the blue-books of the old home-country. No time has been lost, moreover, in the prosecution of researches which furnish something worthy to record,

FIG. 1.—Waterberg sandstones near Balmoral, containing fragments of Pretoria quartzite.

and the results have here been illustrated on an excellent and liberal scale. Topographic work has been undertaken where existing surveys are deficient, and it seems probable that the geologists will run ahead, for some years to come, of the accurate mapping of the country. The beds dealt with are, firstly, the Pretoria series of quartzites and shales, which must have a high antiquity; secondly, the Waterberg sandstones and grits, which are now for the first time proved to be distinctly unconformable on the Pretoria series; and thirdly, the Karroo system, or rather systems, which opened under Glacial conditions, and were laid down on the denuded surface of the folded Waterberg series.

The two earlier series are thus clearly pre-Carboniferous. The Pretoria series is in places enormously swollen by the intrusion of diabase, which has worked its way along the bedding-planes with remarkable regularity. Where it breaks across the beds, it becomes slightly modified and charged with fragments from the quartzites. The Waterberg series near Balmoral has been invaded laccolitically by a granite, which is correlated with the red granite of the northern Transvaal. On its upper surface, which follows the planes of stratification of the overlying beds, it passes into a platy rock of the compact quartz-porphyry type.

Mr. E. T. Mellor regards the Waterberg series, with its coarse breccias and conglomerates, as deposited in waters swayed by powerful currents, torrents from the land being responsible for the earlier beds. Fragments of the Pretoria quartzites are found in these, affording additional proof of the unconformity (Fig. 1).

The Karroo beds similarly contain boulders of the rocks that preceded them, including the granite that rose beneath the Waterberg series. These boulders occur in the Glacial beds at the base of the system, corresponding with the Dwyka conglomerate of Cape Colony. These beds were laid down in a region already traversed by large streams, and it is very interesting to note that the modern Elands River, Bronkhorst Spruit, and Wilge River have cleared the Glacial beds out of the ancient channels, and have followed in the course of valleys that were long fossilised and lost to view.

As in Cape Colony, the Lower Karroo beds lie on handsomely glaciated surfaces. Dr. Molengraaff directed attention to these in 1898, and Mr. Mellor has described numerous new and admirable instances (Fig. 2). The uniform direction of the striæ from one exposure to another points to an ice-sheet, and not to local glaciers. The fact that the movement was from north to south, speaking in general terms, both in the Transvaal and in Cape Colony, only adds zest to the search for an explanation of this old Glacial epoch in the southern hemisphere. It is satisfactory to find that Dr. Molengraaff now concludes that even in the Vryheid district the ice-movement was from N.W. to S.E., *i.e.*, contrary to his previous suggestion.

Mr. A. L. Hall found in the area allotted to him an interesting series of igneous rocks, including a norite which, near Onderstepoort, has given rise to considerable masses of magnetite by a process of segregation.

FIG. 2.—Glaciated surface (Permo-Carboniferous glaciation), north of Douglas Colliery, near Balmoral.

It is not so clear, however, that similar internal processes, taking place during cooling, will account for the passage of the norite into red granite, described as occurring near the farm of Doornpoort. The facts noted, particularly the mottling of the granite near its margin, where it contains augite and decomposed

hornblende, seem to point rather to the formation of a composite rock along an intrusive junction.

Messrs. Kynaston and Hall conclude this important report with an account of what they style "diamondiferous" pipes and alluvial deposits. It is suggested that the diamond-bearing vents were connected with the great uplift that followed the close of the Karroo period in South Africa.

Some of Mr. Mellor's results, now detailed in the official memoir, were communicated earlier in 1904 to the Geological Society of South Africa, and have been incorporated in Dr. Molengraaff's "Geology of the Transvaal."[1] This handy work, the publisher of which is not named, now replaces the well known paper in the *Bulletin de la Société géologique de France* for 1901. It is accompanied by a coloured sketch map on the scale of 1 : 500,000.

GRENVILLE A. J. COLE.

OUR MUSEUMS.[2]

THE object of the association, of which the manifold spheres of activity are chronicled in the *Museums' Journal*, is the promotion of the better and more systematic working of museums. That museums are destined to play a very important function in the future education of our race every curator is fully convinced. Yet anyone perusing the pages of the *Museums' Journal* will be struck by the apparent want of unanimity among those into whose charge such institutions have been placed as to the best methods to be adopted in conveying to the public the educational advantages offered. A learned German museum official thought that if artistic skill were more cultivated the public would show increased appreciation for museums. He insists that the greater the knowledge of drawing in a community, the greater the value of a museum as an educational institution for a nation. Dr. Hecht, a French museum authority, advocates placing among natural history specimens a number of attractive and pleasing exhibits so as to lead the mind of the visitor to larger ideas, and to show him by well chosen illustrations in how many ways animal life is connected with human civilisation. Another gentleman argues that the doctrine of evolution should be the key-note of museum work, while Mr. Pycraft directs attention to a real defect in many of our museums in the manner in which our animals are mounted. He gives as an instance how the train of the peacock, commonly called its "tail," is often placed as if it arose from the hinder end of the body, while in reality when erect it stands in front of the wings, as shown in the accompanying illustration reproduced from Mr. Pycraft's paper.

"Would it not be well," remarks Dr. Bather very aptly in his excellent presidential address at the Aberdeen conference of the Museums' Association, "for each of us Museum curators occasionally to ask himself the question: What exactly is the object of my Museum?" While laying stress on inspiration as one of the principal functions of a museum, by which Dr. Bather understands the selection and display of material so as to attract members of the general public,

FIG. 1.—Side view of the Peacock in display showing that, when erect, the train stands in *front* of the wings, and not behind them. From the *Museums' Journal*.

he does not, however, touch upon the really vital point to the museum curator—how can we best induce the community to enter the doors of our institutions?

The scope of museums is extended from year to year, and everything is done to widen the sphere of their usefulness. A museum is no longer a place for exhibition only, but a place for research and investigation, and for the encouragement of those who desire to devote their time to such. Yet no one like the museum curator is more impressed with the fact that, in spite of all his efforts to make his collections appeal to the public, in spite of his heartfelt desire to teach both old and young, he only succeeds in attracting within the walls of the institution a comparatively small percentage of the community. What is really wanted, it seems to us, is that schools and museums

[1] "Geology of the Transvaal." By Dr. G. A. F. Molengraaff. Translated by J. H. Ronaldson, M.E. With Additions and Alterations by the Author. Pp. viii+90. (Edinburgh and Johannesburg, 1904.)

[2] *The Museums' Journal*. Edited by E. Howarth. Vol. iii. (July, 1903, to June, 1904). Pp. x+436 and 73–142. (London: Dulau and Co., 1904.) Price 12*s.* net.

should work hand in hand to aid one another in the supreme object of education. A beginning in that direction has been made in the United States and in some towns in England, where the young are taught in the lecture theatre and are then conducted by the teacher to the section of the museum dealing with the subject of the discourse. In this way the young are familiarised with the objects and uses of museums, to which they will surely more readily return in after life, and in the development of which they will take a keener interest than they do at present. R. F. S.

DR. FRANK McCLEAN, F.R.S.

IN Dr. Frank McClean astronomy has not only lost one of her most devoted and painstaking followers, but a generous benefactor that can ill be spared, especially in this country. His death came as a surprise to most of his friends, for, although it was known that his increasing years were beginning to tell on his general activity, it was thought that there was still much work left in him. Unfortunately, however, this was not to be, for, at the latter end of his usual trip on the Continent, he was taken ill at Brussels, and very shortly afterwards passed away on November 8 at the age of sixty-seven, surrounded by members of his family.

Dr. McClean was the son of the late distinguished engineer, Mr. J. R. McClean, F.R.S., and was born in 1837. After the completion of his education at Westminster, the College, Glasgow, and Trinity College, Cambridge, of which he was a scholar, graduating in 1859 as a wrangler, he took up the profession of his father, and became apprenticed in the same year to Sir John Hawkshaw; three years later he was taken into partnership in the firm of Messrs. McClean and Stileman.

Up to the year 1870 his energy was directed to engineering matters, but retiring from his profession, he devoted the remaining years of his life to spectroscopic researches in connection with the sun and stars. The success which rewarded his endeavours is best shown by the numerous important papers which he communicated to the Royal Society and Royal Astronomical Society, and by the fact that the council of the latter society awarded him, in 1899, the gold medal, their highest honour for astronomical research. The crowning work, which he fortunately completed, and with which his name will always be associated, was the conception and carrying out of the great spectroscopic survey of the brighter stars over the whole celestial sphere.

He commenced his spectroscopic work with several important researches, all of which were carried out with zeal, patience, and thoroughness; these were naturally closely allied, in fact preliminary steps, to the great work to which he later devoted his energies. The first of these dealt with the photography of metallic spectra by means of an induction spark, after which he turned his attention to the nearest star, the sun, and made an elaborate series of comparative photographs of the spectra at high and low altitudes. An account of this, accompanied by a beautiful atlas of plates, was submitted in 1890 to the Royal Astronomical Society. The high sun spectrum was taken as far as possible when the sun's altitude was more than 45°, and the low sun when it was under 7½°, so that the depth of atmosphere traversed was in the proportion of one to five respectively. For securing these photographs he employed a fixed heliostat to reflect the solar light into a telescope fixed parallel to the polar axis, in conjunction with a spectroscope in which was used a large Rowland plane grating.

The investigation brought out in a striking manner the different effects of atmospheric absorption in the solar spectrum, and put one on a firmer footing as regards the variations due to atmospheric influences.

After the publication of these results, McClean turned his attention again to terrestrial spectra, and made a minute study of the comparative photographic spectra of the sun and metals. The first results were connected with the spectra of the gold and iron groups of metals. These spectra were collated by means of their common air lines with the iron spectrum, and so by means of the iron lines with the solar spectrum. In the gold group he found many lines due to these metals which up to that time had not been observed, and he also remarked some curious coincidences that existed between the air lines in the metallic spectra and lines in the solar spectrum. That he had in his mind the eventual spectroscopic study of the heavenly bodies is shown even in his brief accounts of these experiments, for in one case he writes, "the spectra of the metals appear to me to be fairly within the scope of astronomy, as our knowledge of them forms the basis of any knowledge we possess of the composition of the heavenly bodies."

At the end of 1891 he published another set of comparative spectra of the sun and metals. The two series consisted of six sections, corresponding to six sections of Angstrom's chart; they were as follows:—

Section i. contained the spectra of the sun, iron, platinum, iridium, osmium, palladium, rhodium, ruthenium, gold, and silver. The last eight constitute the platinum group of metals.

Section ii. contained the spectra of the sun, iron, manganese, cobalt, nickel, chromium, aluminium, and copper. These seven metals constitute the iron copper group.

Throughout McClean's scientific career his greatest work was undoubtedly the spectroscopic survey of every star brighter than 3½ magnitudes scattered throughout the whole celestial sphere.

Such a programme seemed large for one man to tackle single-handed, but McClean was equal to the occasion, and succeeded not only in accomplishing it, but in discussing and publishing the results.

For the northern stars the photographs were secured at his home, Rusthall House, Tunbridge Wells. The instrument employed was a photographic telescope having an object glass of twelve inches diameter, and carrying an objective prism of the same aperture, with a refracting angle of 20°.

To secure the southern stars McClean worked at the Cape of Good Hope from May to November, 1897. He took with him the prism he had already used for the northern work, and fixed it in front of the object glass of the well-known Cape astrographic instrument, which had been placed at his disposal by Sir David Gill. Both series of photographs were thus secured with practically identical instruments, the advantage of which it is difficult to overestimate.

Space does not permit, nor is it here necessary, to enumerate at any length the results of such a far-reaching research, which were so ably discussed, and received such high praise. Mention, however, may be made of the originality he displayed in referring the stars to galactic latitude and longitude, instead of employing the usual system of right ascension and declination. The celestial sphere he divided into four equal areas by drawing a circle at a radius of 60° from each galactic pole. By means of a great circle passing through the galactic poles, he cut the sphere into two halves, so that each of the four areas was again equally divided. This apparently simple portioning of the heavens was amply rewarded.

In discussing the relation of special type stars to the Galaxy, one of the chief facts that made itself at once apparent was that "Helium" stars were not indiscriminately scattered over the heavens like the solar or other type stars, but were more thickly concentrated in the two zones north and south of the galactic equator. In addition, among many other outcomes of this survey was the discovery of oxygen in the spectrum of β Crucis, and in the helium stars generally.

The energy and stamina displayed by McClean in all his work will be best understood when it is mentioned that he employed no assistants. In his laboratory he was the sole operator, and in the observatory at night every manipulation was accomplished by his own hands. To quote the words of the president of the Royal Astronomical Society when presenting him with the gold medal, ". . . . it was his eye that measured the lines, and his was the pen that worked out the calculations. Need I add more to prove that what Mr. McClean's hand had found to do he did with all his might?"

Turning now from this very brief and incomplete summary of McClean's scientific work, reference must be made to his generosity in presenting munificent gifts for the advancement of astronomy. Being a worker himself, he was in a position to know in what direction monetary aid could be best employed. As the founder of the Isaac Newton studentships at Cambridge University, requiring an endowment of 15,000*l.*, he rendered a service to astronomical science which it would be hard to overestimate, and the results that will accrue from it will, we hope, be a fitting memorial to his name.

Not content with providing in this way the means by which the study of astronomy will be encouraged, he presented the Cape Observatory, ten years ago, with a large telescope, fittings, and dome, with all the latest improvements, to accomplish work which otherwise would have been delayed possibly for many years. He saw at once the field that was open and the advance that was possible if the southern heavens were surveyed by a prismatic camera of large dimensions, and he took this opportunity to supply the necessary means.

The fact that Sir David Gill in his recent report for the year 1903 writes, "The Zeiss prism is a very perfect and transparent piece of glass, and I have no doubt that its performance will do credit to the fame of its makers. The observatory is indebted to Mr. McClean for this splendid gift, as also for the costly alterations to the spectroscope," shows that McClean's original gift has been greatly increased. As the inauguration of the "Victoria" telescope forms an epoch in the history of the Cape Observatory, may the results obtained with it play a like *rôle* in the advancement of stellar spectroscopy for the southern hemisphere.

McClean was elected a fellow of the Royal Society in 1895; the university of Glasgow conferred on him the honorary degree of LL.D., while, as previously mentioned, he obtained the gold medal of the Royal Astronomical Society.

In 1865 he married Ellen, the daughter of Mr. John Greg, of Escowbeck, Lancaster, who now mourns with her three sons and two daughters his loss. They are not, however, alone in their grief, for his death is deeply felt by a large circle of friends, among whom are many astronomical colleagues who will miss his familiar face.

The funeral, which took place on Friday last, was attended by representatives from many societies and institutions, among which may be mentioned the Cambridge University, the Royal Society, the Royal Astronomical Society, the British Association, the Institution of Civil Engineers, Greenwich Observatory, Solar Physics Observatory, and the Cambridge University Observatory.

W. J. S. L.

NOTES.

THE seventieth birthday of Prof. G. H. Quincke, the doyen of German physicists, will be celebrated at Heidelberg on Saturday next, November 19. Prof. Quincke's laboratory formed the subject of a contribution to our series of scientific centres in NATURE of April 24, 1902, and his portrait was reproduced in the article. Reference was then made to the admirable manner in which the laboratories at Heidelberg are arranged, and the many ingenious devices to be found in them, as well as to some of the investigations carried on. It is therefore unnecessary to attempt to describe again the results of Prof. Quincke's uninterrupted work in physical research for nearly half a century. Among Prof. Quincke's many pupils have been Prof. Lenard (Kiel), Prof. Braun (Strassburg), Prof. W. König (Greifswald), Profs. Elster and Geitel (Wolfenbüttel), the late Prof. Willard Gibbs, Prof. Michelson, Dr. J. T. Bottomley, F.R.S., Dr. J. McCrae (Glasgow), &c.; a complete list would include many other English and American students. To celebrate the occasion of Prof. Quincke's seventieth birthday, a committee, with Prof. Kohlrausch (Berlin) as president and Dr. R. H. Weber (Heidelberg) as secretary, has arranged for the presentation of a large and handsome album containing the autograph photographs of many of the leading physicists of all nationalities and of Prof. Quincke's former pupils. A convincing testimony of the high value set on Prof. Quincke's work in this country is supplied not only by the lists of universities and learned societies which have conferred their honours on him, but also by the fact that among the English physicists and personal friends who have contributed photographs are Lord Kelvin, Lord Rayleigh, Sir W. Huggins, Sir W. Ramsay, Sir H. E. Roscoe, Sir N. Lockyer, Sir W. H. Preece, Prof. J. J. Thomson, Sir A. Rücker, Prof. J. Larmor, Prof. J. A. Ewing, Mr. C. V. Boys, Sir O. Lodge, Prof. J. H. Poynting, Prof. G. Carey Foster, Prof. A. Schuster, Dr. W. N. Shaw, Prof. J. Perry, Prof. R. B. Clifton, Prof. J. G. MacGregor, Prof. J. T. Joly, Prof. G. H. Darwin, Prof. W. G. Adams, Prof. W. M. Hicks, Prof. H. Stroud, Prof. A. P. Chattock, Prof. A. S. Herschel, and many others.

THE American Consul at Bermuda describes in a United States Consular Report the steps which have been taken to establish there a biological station which will be to North America what the Naples station is to Europe. For several years American naturalists have carried on investigations of the natural history of the Bermudas and the surrounding sea, and have made efforts to establish a biological station in these islands. Upon the advice of the Royal Society, our Government has given its assent to the project. The Colonial Government has expressed its willingness to purchase the land and erect the building, and grants toward equipment and support of tables have been made by the Royal Society and the Carnegie Institution. Harvard University and New York University, in connection with the Bermuda Natural History Society, have already commenced work in a temporary laboratory close to what will be the permanent quarters of the station, and the United States Government has been asked to give generous support to the station. America has already founded a tropical botanical laboratory in buildings of the Government of Jamaica at

Cinchona, and has now secured a biological station, so that it appears as if the Americans are rapidly getting the control of the scientific interests of our western tropical possessions. While we cannot but admire the interest shown in the establishment of these stations by universities and colleges in the United States, it is impossible not to regret the apathy with which our home and colonial Governments regard such matters. Surely it is the duty of the State to encourage the pursuit and cultivation of natural knowledge throughout the Empire, and to realise the richness of its possessions in material for scientific study as well as in precious minerals. It is a reproach to our nation that a biological station has not been established by us in the Bermudas; for now, instead of American investigators carrying on their work in a British station, we have to face the fact that, though the station will be on British soil, it will belong to the United States, and our own countrymen will be guests in it. So far as the interests of science are concerned, probably this does not matter; for, as Mr. Balfour wrote a few days ago to the translator of his British Association address, community of aim "binds together the scientific men throughout the world into one international brotherhood." But it should be evident to some of our ministers, at least to Mr. Balfour, who has often expressed sympathy with scientific progress, that it cannot be to the advantage of the State for another nation to accept responsibilities which belong to us. Mr. Balfour is gratified at the success of the translation of his address into German, but apparently he does not consider that the interest shown in scientific matters in Germany is due to the active and practical part played by the State in helping scientific education and research. What we want here and in all parts of the Empire is more practical help of the kind given by the United States and Germany to save us from the future regret of lost opportunities.

REUTER'S Agency states that a long report has been received from the members of the expedition of the Liverpool School of Tropical Medicine now investigating sleeping sickness in the Congo. Complete observations have been made on the spread and distribution of sleeping sickness along the Congo River for a distance of nearly 1000 miles between Stanley Pool and Stanley Falls. From Leopoldville to Bumba cases of sleeping sickness were present in every town visited, and a large percentage of the population harboured trypanosomes. From Basoko to the falls only imported cases were met with, with two exceptions, and trypanosomes were not found among the general population. Observation seems to show that enlarged cervical glands are an early sign of the disease, recognisable before trypanosomes make their appearance in the general circulation, and in a little fluid withdrawn from a gland with a hypodermic needle trypanosomes may be detected. Tsetse flies were incessantly present up to Basoko, the species being *Glossina palpalis*, after which they became infrequent, their distribution thus corresponding with that of sleeping sickness.

MR. W. H. PICKERING, late chief of the inspecting staff for the Yorkshire and Lincolnshire mining districts, has been appointed Chief Inspector of Mines in India.

DR. CATTO has been awarded the Craggs prize of the London School of Tropical Medicine for his discovery of a new *schistosomum* parasite of man. The Craggs prize, of the value of 50*l.*, was founded some years ago by Sir John Craggs, and is awarded annually in October to that student of the London School who is considered to have carried out the best piece of research work, or made an important discovery, in tropical medicine during the preceding year.

IN a letter to the *Speaker* of November 5, Mr. J. A. Reid urges that educationists should consider the desirability of teaching children the principles of evolution in schools. In considering how the subject might be taught, Prof. W. K. Clifford remarked in 1878: "The teacher, knowing what is to come in the end, may so select the portions of various subjects which he teaches at an earlier stage that they shall supply in a later stage a means of understanding and estimating the evidence on some question of evolution."

THE inaugural meeting of the Association of Economic Biologists was held at Burlington House on Tuesday, November 8. Mr. F. V. Theobald occupied the chair, and in the course of his introductory remarks he detailed the steps taken by Mr. Walter E. Collinge to found the association. He hoped that the association would welcome all investigators in economic biology, whether agricultural, medical, or commercial. The relationship between biology and agriculture was apparent to all, but only recently had the importance of its relationships with medicine and commerce been realised. Membership of the association will be confined to workers in economic biology. The following officers have been elected for 1904–5:—president, Mr. Fred V. Theobald; vice-president, Mr. A. E. Shipley, F.R.S.; council, Prof. G. S. Boulger, Prof. A. H. R. Buller, Prof. Geo. H. Carpenter, Dr. Francis Marshall, Mr. Robert Newstead, Major Ronald Ross, F.R.S., Mr. Fraser Storey, Mr. Cecil Warburton; hon. treasurer, Mr. Herbert Stone; hon. secretary, Mr. Walter E. Collinge. The next meeting will be held at Birmingham in April, 1905.

ON December 4, 1804, Joseph Lebon, who is considered in France as the inventor of lighting-gas, was found murdered by an unknown hand in the Champs-Elysees, near the site where is now the Grand Palais. In memory of this sad tragedy, and to pay due honour to the celebrated inventor, the Compagnie Parisienne du Gaz has given a certain quantity of gas, free of charge, to the Aëro Club and Société française aërienne. Ascents will accordingly be made on December 4 by members of these two societies. On December 5 an exhibition will be held in the Grand Palais by the Automobile Club.

AT a meeting of the Société astronomique de France held in Paris on November 2, M. Lippmann being in the chair, the Comte de la Baume-Pluvinel gave an address on the forthcoming total eclipse of the sun on August 30, 1905. He mentioned the intentions of American astronomers to send expeditions to Labrador, Spain, and Upper Egypt. After the address the society decided to appoint a committee for determining the part which France should take in observing the eclipse. It is fairly certain that the principal work of this committee will be concerned with observations in Algeria and Tunis, through which the line of totality passes. This eclipse was also commented upon at the last meeting of the St. Petersburg Scientific Aëronautic Congress, officially held in the rooms of the Imperial Academy of Sciences under the chairmanship of the Grand Duke Constantin Constantinovitch, president of the academy. Colonel Vives y Vich has announced that he will make an aëronautical ascent from Burgos on this occasion, for the purpose of ascertaining the part the clouds may possibly play in the apparent brightness and shade of the corona. In addition, the international committee of *ballons-sondes* has decided that atmospheric observations shall be made at the great altitudes of the various observatories connected with the institution during August 29, 30, and 31 for ascertaining the changes the eclipse may introduce in the prevailing winds and temperatures at different altitudes.

THE *Scientific American* of October 22 contains the portrait of a white raccoon-dog from northern Japan, in the New York Zoological Park, which is regarded as representing a new species, and is accordingly named *Nyctereutes albus*. The ordinary raccoon-dog of Japan and China is an animal closely allied to the true dogs, but with a marked superficial resemblance to a raccoon. If the New York specimen really indicates the existence of a white species of raccoon-dog, the fact will be of considerable zoological interest.

IN the second part of the Bergen Museum *Aarbog* for the current year Prof. G. O. Sars describes a small crustacean (*Paracartia grani*) recently discovered in the oyster-beds of western Norway which is of great interest from the point of view of distribution, since the only other known representative of the genus inhabits the Gulf of Guinea. The author considers that the creature reached Norway from the south during a warm period, and that it survives on the bays of the west coast owing to the circumstance that a superincumbent layer of fresh water renders the subjacent salt water unusually warm. The same explanation accounts for the prolific oyster-beds on this coast.

IN the November number of the *Century Magazine* Prof. H. F. Osborn publishes *in extenso* the lecture on the evolution of the horse in America which he delivered at the recent Cambridge meeting of the British Association. Omitting reference to that portion of the article devoted to the origin of the Equidæ generally, we may mention that the author regards North America as the ancestral home of the genus Equus, the American horses passing into South America by way of Panama, and into Asia by a land-bridge across Bering Strait about the early or middle portion of the Pliocene period, giving rise in the latter area to the Siwalik horses (which, by the way, are not later than older Pliocene age). Horses of all kinds died out both in North and in South America, according to the author's belief, before the European conquest. The American Miocene and Pliocene horses are considered to have been striped; but the splitting of Equus into the true horses, asses, and zebras probably took place in the Old World. Przewalski's horse of Mongolia is regarded as representing the ancestral stock of the ordinary horses of the Old World, the long manes and tails of the latter being probably due in part to domestication. On the other hand, the author accepts the view that the blood-horse may have had a different ancestry, although he does not refer to its suggested derivation from the Indian *Equus sivalensis*.

SOME interesting experiments in blasting tree butts with gellignite—a safety explosive—have recently been carried out at Lord Leigh's Stoneleigh Abbey Estate, near Kenilworth. The usual boring was made and filled with the explosive. An electric detonator was used which enabled the operator to retire under cover at a safe distance. The butts operated upon were of various sizes and species, but in each case the method was found to give satisfactory results. It is also claimed to combine efficiency with economy.

THE comparative age of the different elements of the flora of eastern North America forms the subject of a paper by Dr. J. W. Hashberger in the September issue of the *Proceedings* of the Philadelphia Academy. Most of the flora cannot be older than the close of the Glacial period, which, from the rate of cutting of the Niagara gorge, is estimated to have occurred not more than 15,000 years ago. Some of its elements may, however, be much older, since they may be the descendants of boreal plants which flourished on unglaciated areas in the midst of the ice-sheet. Apart from these, there was firstly a wave of plant-life from the skirts of the ice-sheet. This was followed by a northern wave, many of the species of which, forming the bog-plants of the old Glacial lakes, soon occupied the tundra left by the ice; the conifers developed later, and restricted the bog-flora. Hence came the modern bog and swamp floras, while the existing Poccona flora is due to a third invasion.

THE work of the Forestry Bureau of the United States Department of Agriculture stretches far afield, and the forests of the Hawaiian Islands form the subject of one *Bulletin* by Mr. W. L. Hall, while Mr. W. L. Bray in another reviews the forest resources of Texas. The succession of the forests in Texas indicates that their distribution is primarily influenced by the amount of rainfall, and only secondarily by the nature of the soil. A remarkable instance of the spread of a successful type is furnished by the mesquite, *Prosopis glandulosa*, which has spread from the Rio Grande eastwards across the Rio Brazos, and northwards into the adjoining States of Oklahoma and Kansas. In the Hawaiian Islands a mesquite, although an alien, has established itself as a pure forest from sea-level to an elevation of several hundred feet, and is regarded as a valuable asset, because, in addition to the fuel and posts obtained from the wood, the pods furnish excellent food for stock.

IN view of the difficulties of obtaining zygospores of species of Mucor and allied genera, considerable importance attaches to a paper—"Sexual Reproduction of the Mucorineæ," by Mr. A. F. Blakeslee—which is published in the August number of the *Proceedings* of the American Academy of Arts and Sciences. The author found that the greater number of these fungi failed to produce zygospores in pure cultures, but some would do so when a mass of spores taken from an impure culture was sown together. This suggested that in the latter case zygospores were produced from different mycelia or plants, and eventually experiments demonstrated that two different strains, which may be regarded as a (+) and a (−), were required; thus two groups, the *heterothallic* and *homothallic*, are distinguished. Sporodinia is homothallic, Phycomyces, Rhizopus, and several species of Mucor are heterothallic. Differences of colour, luxuriance and duration of conjugating ability were noted, but the most interesting results obtained were incipient attempts at hybridisation by opposite strains of allied heterothallic forms.

WE learn from the *Standard* that, under the auspices of the Meteorological Council, a new observing station for London has just been established in St. James's Park. The station is situated in an open spot a few yards distant from the iron railings bordering on the Horse Guards Parade, and is equipped with a set of thermometers, mounted in a Stevenson screen, and two rain gauges—one of quite an ordinary kind, the other a self-registering gauge of the pattern designed by Mr. F. L. Halliwell, of Southport. Just within the park railings are placed two ornamental wooden frames, one containing, for the previous twenty-four hours, automatic records of bright sunshine, of rainfall, and of temperature, all made in Westminster; the other, copies of the latest weather charts and forecasts prepared at the Meteorological Office.

WE have received a copy of the results of the magnetical and meteorological observations made at the Royal Alfred Observatory, Mauritius, in the year 1901. The observatory has a complete equipment of instruments recording photo-

graphically the variations of the principal magnetic and meteorological elements and of earth movements, in addition to a self-registering "Beckley" rain gauge and other automatic apparatus. The tables, containing hourly and mean values, have been carefully prepared on the Greenwich pattern, and are, therefore, quite clear and convenient for reference. Mr. Claxton prints the results of an interesting investigation of the degree of accuracy of self-registering maximum and minimum thermometers. He finds that maximum thermometers read higher in a horizontal position than when inclined to the horizon; the excess may amount to 1° F. Also, that the indications of spirit minimum thermometers are untrustworthy, owing chiefly to evaporation of the spirit. They should be used in conjunction with an ordinary mercurial thermometer.

A PAPER on Britain's place in foreign markets is contributed to the *Economic Journal* for September by Prof. A. W. Flux. The author has had considerable difficulty in drawing up statistics owing to the great discrepancies which he finds in the returns from different countries. He, however, considers that the market for British goods in Germany, France, and the United States, though narrowed by the tariff policy of the third, is still of great importance, and is expansive in some degree except in the case of the United States. In all three cases, however, the trade done by other countries as a whole has grown faster than their trade with us.

DURING March, 1903, several excursions were made to the Phlegræan fields of Naples by Dr. G. de Lorenzo and Sir Archibald Geikie. At the suggestion of the latter the former has now published a short history of volcanic activity in this region (*Rendiconto* Naples Academy, May to July). Dr. de Lorenzo divides the volcanic formations into three periods, the first being represented by the pipernoid tufa of the Campagna and by conglomerate and breccia at Cuma, Camaldoli and Procida, the second by the yellow tufa of Posilipo, Nisida, Pozzuoli, Capodimonte, &c., and the trachitic masses of the Vomero, and the third period by the eruptions of the Solfatara, Monte Nuovo, the Lago d'Agnano and similar formations.

IN the *Rendiconto* of the Naples Academy for March and April, Prof. Orazio Rebuffat describes some interesting and simple experiments with radium salts. When a glass rod was rubbed with wool in the common way for producing electric sparks the author found that if the experiment was performed in a medium containing a radium salt a luminous glow followed the wool, and when the finger was brought near the excited glass a glow was again seen. By taking a vacuum tube and opening connection with a small tube containing a salt of radium, and then rubbing the outside of the glass tube with wool, a brilliant glow was seen within. By means of this experiment Prof. Rebuffat considers it possible to demonstrate the production of emanations from radium preparations of very feeble activity.

DR. R. VON LENDENFELD, of Prague, has published in *Globus*, lxxxv., 24, a discussion of the melting of glaciers in winter. The author considers that the earth's interior heat is incapable of accounting for any considerable part of the phenomenon; indeed, he only attributes about 3 per cent. to 6 per cent. of the result to this cause. Another cause which may account for a further 1 per cent. is the slow conduction of the summer heat to the interior. The main cause of the melting is attributed to the heating of the ice by the work done in its descent. This work is converted into heat in overcoming friction, viscosity, and similar resistances, just as in Joule's classical experiments. A further increase in the internal melting during the winter is probably due to the pressure produced by the winter snows.

A SPECIAL report of the seventy-sixth meeting of the German Association of Naturalists and Physicians is contained in the number of the *Physikalische Zeitschrift* for October 20. The meeting was held at Breslau from September 18 to 24, and the physical papers include the following:—E. Hoppe, constitution of magnets; H. Hartl, lecture apparatus; C. Pulfrich, coast surveying, &c.; F. Müller, vacuum apparatus; C. Dieterici, energy of water and its vapour; W. Scheffer, stereoscopic problems; A. Köhler, photomicrography by ultra-violet light; J. Stark, mercury lamps of quartz glass; O. Lummer and P. Weiss, *n*-rays; W. Nernst, chemical equilibria at high temperatures; L. Grunmach, properties of emanium and liquid nitrous oxide; A. Wehnelt, negative ions from incandescent metallic oxides; O. Lummer, resolution of fine spectrum lines; W. Schmidt, models of wave motion; H. T. Simon, a phasemeter; M. Reinganum, molecular volumes of halogen salts; L. Graetz, radiations from hydrogen peroxide; J. Rosenthal, Sprengel pumps; W. Stern, tone-variators; K. Schreber, explosion motors, also force, weight and mass; G. Bredig and F. Epstein, kinetics of adiabatic reactions; and E. Meyer, combustion engines. In addition a discussion took place on mathematical and scientific teaching in the higher schools, including addresses by K. Fricke, F. Klein, F. Merkel, and G. Leubuscher. In the general meetings papers were read on the Ice age by Messrs. Brückner, Meyer and Partsch, on the Antarctic expedition by Prof. Gazert, and on biological mechanics by Prof. Roux.

THE scientific methods which have characterised Japanese operations in the Far East are not the only results of the well developed system of education which the last thirty-five years has seen established in Japan. Some fifty years ago Japan was a hermit nation more than five centuries behind the times, to-day she constitutes a new and important factor in the problem of the distribution of the world's commerce. The story of the foreign commerce of Japan since the restoration of imperial authority in 1868 is told by Mr. Yukimasa Hattori in Nos. 9 and 10 of series xxii. of the *Johns Hopkins University Studies in Historical and Political Science*, copies of which have reached us. Mr. Hattori considers his subject under three headings: the volume of trade, the character of Japan's commerce, and the geographical distribution of trade. Two remarks towards the end of his paper will show the conclusions to which Mr. Hattori has come. "Japan must rely on industrial development rather than on agriculture, and must try to excel in the quality of the goods produced rather than in quantity." "Japan possesses all the advantages necessary to make her a great manufacturing country. Her people possess exceptional skill, and labour is relatively cheap; coal is abundant, and the raw material is easily obtainable either at home or in the neighbouring countries." Those readers who have followed the steps in Japan's development since 1868 will be prepared to agree with Mr. Hattori that his country is but "at the very beginning of beginnings" of what will yet be seen.

A SECOND edition of Mr. Drinkwater Butt's "Practical Retouching" has been published by Messrs. Iliffe and Sons Ltd., at 1s. net.

MESSRS. MACMILLAN AND CO., LTD., have in the press an English translation of Dr. Cohnheim's "Chemistry of the Proteids," prepared with the author's sanction from the second edition of that work by Dr. Gustav Mann, of the physiological laboratory at Oxford, and author of "Physiological Histology." Dr. Cohnheim's book, which, in its second edition, has been entirely re-modelled, deals with all recent advances made in analysing and synthetising proteids. Several special features have been introduced into the English translation, and some of the chapters have been re-written.

AN English edition of Prof. Weismann's "Evolution Theory," which has been translated, with the author's co-operation, from the second German edition (1904) by Prof. J. Arthur Thomson, of Aberdeen University, and his wife, will be published in two volumes by Mr. Edward Arnold toward the end of this month.

TO commemorate the twenty-fifth anniversary of the founding of the firm of Burroughs, Wellcome and Co., Mr. Henry S. Wellcome is arranging an exhibition of historical objects in connection with the history of medicine, chemistry, pharmacy, and the allied sciences, the object being to illustrate the art and science of healing in all ages. The date of the opening of the exhibition is not yet fixed.

THE Cambridge University Press will publish very shortly in the Cambridge Biological Series "Morphology and Anthropology," by Mr. W. L. H. Duckworth. The volume will present a summary of the anatomical evidence bearing on the problem of man's place in nature. The Cambridge University Press has also in preparation "Studies from the Anthropological Laboratory in the University of Cambridge," by Mr. Duckworth.

THE November number of the *Popular Science Monthly* is devoted entirely to the St. Louis Congress of Arts and Science. The representative administrative board, it will be remembered, adopted the plan proposed by Prof. Münsterberg, of Harvard University, to hold one congress of the arts and sciences which should attempt to promote and demonstrate the unity of science. An appreciation of the work of this international congress, interspersed with portraits of representative men of science from various parts of the world, is contributed by Mr. W. H. Davis, of Lehigh University, one of the secretaries. A selection from the addresses given at the congress completes an interesting number of the magazine.

OUR ASTRONOMICAL COLUMN.

ENCKE'S COMET (1904 *b*).—A telegram from Prof. Max Wolf to the *Astronomische Nachrichten* (No. 3975) states that on October 28 the ephemeris published by M. Kaminsky in No. 3973 of that journal needed corrections of +11s. $-2'\cdot4$, and, further, that the magnitude of the comet was 12·5.

Visual observations have not, as yet, been fruitful. Prof. E. Millosevich vainly sought for this object on September 15 and October 5.

DESLANDRES'S FORMULA FOR THE LINES IN THE OXYGEN BAND SERIES.—Referring to a note on the results obtained by Mr. O. C. Lester concerning the oxygen bands in the solar spectrum, which appeared in these columns on October 20, Prof. Deslandres directs attention to the fact that a modification of his first formula (viz. $N=a+bn^2$), equivalent to that now proposed by Mr. Lester, was published by him in his original (*Comptes rendus*, August, 1886) and succeeding memoirs on this subject.

Mr. Lester's statement that the first law requires the modification which he proposes is obviously justified, but he appears to have omitted to study the original memoirs, and to have accepted the epitomised and generally known results as being complete. This does not, however, lessen the importance of the valuable experimental results he obtained in measuring the old and new bands on his large dispersion photographs.

ANNUAL REPORT OF THE CAPE OBSERVATORY.—In the report of the Cape Observatory for 1903 Sir David Gill records several important additions to and modifications of the instrumental equipment.

The work of the new transit circle has been greatly facilitated, and the results improved by the adaptation of a Repsold automatic transitting device to the instrument.

The line-of-sight spectroscope which is used in connection with the Victoria telescope has been re-modelled, and an extremely delicate thermostatic arrangement has been fitted so that the temperature of the prism box can be maintained constant, within $\pm 0^{\circ}\cdot05$ F., during a three or four hours' exposure.

In the astrophysical department several stellar spectra have been completely reduced in the region λ 4200 to λ 4580, and those of Canopus and Sirius have been discussed in connection with the corresponding terrestrial origins of their lines. The results of the line-of-sight work have been made more trustworthy by measuring only those lines which, on traversing either the thin or the thick ends of the prisms, show no relative displacement, and α Phœnicis has been shown to have a very large radial velocity. In December this star was apparently receding from us at the rate of 105 km. per second.

A large amount of routine work in connection with the maintenance of an efficient time service and the completion of the Cape zone for the astrographic chart was accomplished during the year. Important operations were also carried out in connection with the geodetic survey of South Africa, whilst the Government survey of the Transvaal and the Orange River Colony and the topographic survey of South Africa have been planned, the former having been commenced.

THE TRANSITION FROM PRIMARY TO SECONDARY SPECTRA.—Some very interesting experimental results, obtained with the idea of determining as definitely as possible the points at which, under various conditions, the primary is replaced by the secondary spectrum in gases, are published by Mr. P. G. Nutting in No. 2, vol. xx., of the *Astrophysical Journal*.

The general method was to determine what current capacity caused the above named change when either the wave-length, the pressure, the nature of the gas, the inductance or the resistance was altered, and this was called the "critical capacity."

Among other results the experiments showed that this critical capacity is a function of the wave-length, and that it increases slightly as the pressure decreases down to about 1 mm. of air, when it suddenly becomes infinite. All the elements tested have the same critical capacity for the same wave-length and pressure, although the critical point is more marked in some elements than in others. The introduction of inductance always relatively weakens the secondary and strengthens the primary spectrum, although no amount of inductance will completely annul the effects of capacity. Resistance acts similarly to inductance. The critical capacity of any vapour in a mixture of vapours was shown to be the same as when no other gases were present.

NEW BUILDINGS OF THE UNIVERSITY OF LIVERPOOL.

The George Holt Physics Laboratory.

THE George Holt Physics Laboratory, which was declared open by Lord Kelvin on November 12, will be valued by the University of Liverpool as a magnificent addition to its fabric, as well as a memorial to one of the wisest and most generous supporters of that college from which the university has been developed.

The laboratory covers an area of 9600 square feet, and has an average height of 55 feet. The architects are Messrs. Willink and Thicknesse, of Liverpool, with whom there is associated Prof. F. M. Simpson, now of University College, London. The external walls, which are very substantial, are built in best common brick with broad courses of red brick and dressings of Storeton stone. The base-

ment floors are asphalte on a bed of concrete resting on the continuous rock which is the foundation of the whole building. All the upper floors are fire-proof; they consist of a bed of concrete which encases a lattice-work of steel girders, and supports a layer of coke breeze, upon which tongued and grooved pitch-pine boards are stuck down with bitumen and nailed. The resulting surface is both noiseless and steady, and the whole building is made very rigid by the girders employed.

In the basement there is a large workshop, fully fitted with machine tools, store-rooms, a room containing a liquid air plant, a furnace room, an accumulator room, a room for the custody and comparison of standards, and a number of research rooms in which extra steadiness, complete darkness, or constancy of temperature can be respectively secured.

On the ground floor, close to the entrance hall and cloak-rooms, are the doors of the large lecture theatre, a smaller class-room, and a large laboratory for elementary students. This floor also contains the preparation room, the apparatus

FIG. 1.—The George Holt Physics Laboratory, Liverpool.

room, and a sitting-room, office, and private laboratory for the professor.

The first floor is set apart for the teaching of senior students. It contains two large students' laboratories, four smaller rooms suitable for optical and acoustical experiments, a students' workshop, a library, and two sitting-rooms for demonstrators.

The second floor consists almost entirely of research rooms of various sizes. Of these some are designed for special purposes, such as spectroscopy, but the majority are planned so as to be adaptable to as great a variety of needs as possible.

A photographic dark room is provided on each floor; that in connection with the preparation room is adapted for the making of lantern slides and enlargements. There is also a small observatory on the roof, containing a four-inch equatorial telescope.

An electrically driven lift, working in the centre of a tower, is available for the conveyance of heavy apparatus from floor to floor. It can also be used to give access for experimental purposes to all points of two vertical walls which extend to the full height of the tower, about 75 feet. In another part of the laboratory access over a horizontal distance, about 90 feet, nearly equal to the whole length of the building, is secured.

The rooms are heated by low pressure hot water, and are ventilated by an exhaust fan in the roof. They are adequately supplied with gas, with sinks to which hot and cold water are led, with electric power from the corporation mains, and with wires from a switch-board in the basement to which the accumulators are connected. The wiring is run in wood casing on the surface of the walls; all pipes are fully exposed, and, wherever a floor or wall is pierced, an opening is left through which further permanent or temporary connections can be made as required.

The apparatus and preparation rooms have galleries round them, so that their whole wall-space is rendered available for cupboards and drawers. Special devices have been adopted for the ready darkening of the lecture theatre, and for the provision of rigid points of attachment above the whole length of the lecture table. The counter-shafting in the workshop is supported so as to be entirely independent of the rest of the building, and thus silence and freedom from vibration are secured.

The erection of the laboratory was rendered possible by the munificence of a small body of donors, Mrs. and Miss Holt, Sir John Brunner, the late Sir Henry Tate, the executors of the late Rev. J. H. Thom, Mr. Alfred Booth, Mr. Holbrook Gaskell, Mr. J. W. Hughes and Mr. John Rankin, who together subscribed the sum of 23,600*l.*, which by the addition of interest has increased to 25,900*l.* The cost of the building, with furniture and fittings, is 21,600*l.* A sum of 1200*l.* has already been spent upon machinery and new apparatus, and thus about 3000*l.* is available for the completion and maintenance of its equipment.

It is hoped that the general scheme according to which the laboratory is arranged will prove favourable to simplicity and economy of administration, and will allow teaching and research to flourish side by side, not hampering but supporting each other.

New Medical Buildings of the University of Liverpool.

The new medical buildings opened at Liverpool on November 12 go far to complete the university school of medicine in that city in a thoroughly efficient and modern manner. They provide accommodation chiefly for the subjects of anatomy, surgery, and materia medica, the school of dental surgery and the school offices, and forensic medicine. There are four full floors to the building, and the ground plan is of an L shape. One limb of the L-shaped figure joins the fine Thompson-Yates laboratories opened six years ago for physiology and pathology. The other limb forms a wing ending freely towards the north. In the angle of junction of the two portions of the building are placed large theatres, one on the ground floor for surgery, the other upstairs for human anatomy. The pitch of the benching is steep, and the lighting is extremely good from a series of long windows following the curve of the rounded angle of the building. In the wing, lighted by windows east and west, is a spacious museum for anatomical preparations. Above this is a large room for dissection, especially well lighted from the east. An excellent theatre for operative surgery forms a feature of the surgical equipment.

In addition to the theatres, museum, and dissecting room are rooms for a library, and for smaller classes than those the theatres are intended to accommodate. In the front portion of the building is the medical faculty meeting room for transacting the business of the faculty and of its various committees, also for meetings of the veterinary board which manages the newly started university school of veterinary medicine. Next to the medical faculty meeting room is the spacious room providing an office for the Dean of the faculty. No effort or expense has been spared in making the construction at once durable, well lighted within, and handsome from the exterior. Admirable lighting has been secured throughout, even to the basement rooms, which are particularly good, so as to provide a much needed reading room for students. The erection was begun three years ago, and part of the building has already been in occupation for more than a year. The architects are Messrs. Waterhouse, of London, who have designed

most of the older buildings of the university. The group of medical school buildings now in use have cost altogether about 80,000*l.*, including, with the building opened on Saturday, the Thompson-Yates laboratory and the Johnston laboratory. The Chancellor of the university, Lord Derby, formally inaugurated the new buildings on the same afternoon as Lord Kelvin opened the new university laboratory for physics. With these fresh additions to its accommodation and teaching equipment, and with the fine new laboratories for zoology and for electrical engineering now rapidly nearing completion, the University of Liverpool will rank among the best provided university institutions in the country.

PROF. MENDELÉEFF ON THE CHEMICAL ELEMENTS.

THE last half-volume (eightieth) of the new Russian "Encyclopædic Dictionary" contains a remarkable paper by Prof. Mendeléeff on the chemical elements, of which the following is a slightly abridged translation. Together with the articles on matter and on the periodic law, which Mendeléeff contributed to previous issues of the same dictionary, and a paper, "An Attempt at a Chemical Comprehension of the World's Ether," published in a Russian review, this article represents the fundamental physical and chemical conceptions of the great chemist as they now appear in connection with the discoveries of recent years.

"Human thought," he begins, "has always endeavoured to simplify the immense variety of phenomena and substances in nature by admitting, if not the full unity of the fundamental elements (Democritus, Epicurus), at least the existence of a limited number of elements capable of producing all the variety of substances. In antiquity this tendency often resulted even in confusing the phenomena with the substances (earth, water, air, and fire)." Since the time of Lavoisier such a confusion has become certainly impossible: the substances are sharply separated from the phenomena which are associated with them. Of course, there may be partial returns to the old view. "However," Mendeléeff continues, "the solidity of the now prevailing conception as to the profound difference existing between substances and phenomena is the result of such a mass of coordinated knowledge that it cannot be shattered in the least even if a small portion of the men of science return to the "dynamism" of old which endeavoured to represent matter also as one of the forms of phenomena. Consequently we are bound now to recognise the substances (the masses) and the phenomena (the movements) as two quite separate, independent categories, such as space and time, the substance of which our thought has not yet penetrated, but without which it cannot work. Thus, for example, we are far yet from understanding the cause of gravitation, but with its aid we understand many phenomena, even though up till now it is not quite evident whether attraction acts through the aid of an intervening medium or represents a fundamental force which acts at a distance. Progress in the understanding of nature depends, therefore, not upon our reducing everything to one final conception—to one 'principle of all principles'—but in reducing the great variety of substances and phenomena which act upon our senses to a small number of recognised fundamental conceptions, even though these last be disconnected. One of such conceptions is that of the recognised chemical elements.

"The simplest way of conceiving matter in this case is to consider it as the result of combinations of elements which themselves are matter; and the phenomena as the results of movements which are the property of these elements or their aggregations. It was from this point of view that the conceptions were elaborated as to the distinction, not only between phenomena and substances, but also between simple bodies and elements; because the conception of a simple body implies the idea of an impossibility of transforming certain bodies into other bodies, while the conception of a chemical element is merely determined by the desire of diminishing the number of substances which are required for explaining the great variety of the latter."

Mendeléeff passes next to the so-called "rare" elements. Leaving aside historical details concerning them, he remarks that it is the more necessary to dwell upon them as they complete to a great extent our knowledge of the periodic law. "Our information about them," he continues, "can also, in our opinion, contribute towards explaining the relations between the phenomena and the substances in nature; because for the understanding of a multitude of natural phenomena it is necessary to resort to the conception of the so-called luminiferous ether, which by all means must be considered as a ponderable substance, and consequently must have its place in the system of elements, inasmuch as it reminds us of the properties of helium, argon, and other similar elements. The conception of the ether was resorted to at the outset exclusively for explaining the phenomena of light, which, as is known, can be best understood as the result of vibrations of the ether. However, later on, ether, considered as being distributed throughout the universe, was resorted to in order to explain, not only electrical phenomena, but also gravitation itself. In consequence of that, a very great importance has to be attributed to the ether; and as it cannot be considered as anything but ponderable matter, we are bound to apply to it all the conceptions which we apply to matter in general, including also the chemical relations. But as, at the same time, we are bound to admit that this matter is not only distributed throughout stellar space (in order to explain the light which reaches us from the stars), but also penetrates all other substances; and as also we must admit that the ether has no capacity of entering into chemical reactions, or of undergoing any sort of chemical condensation, therefore the above mentioned elements, helium and argon, which are characterised precisely by the absence of that property of entering into chemical reactions with other substances, show in this respect a certain similarity with the ether.[1]"

Referring further to radium, Mendeléeff remarks that there can be no doubt as to its being a separate element, extremely rare in nature. As to the emanation of helium by radium, and the presence of the helium spectrum in the spectrum of radium, he explains these facts by the occlusion of helium in a compound of radium, and considers that "nothing gives us reason to think that radium should be transformed into helium." "Notwithstanding the extremely small quantities of radium occurring in nature, Madame Curie has succeeded in obtaining a compound of it, and in establishing its kinship with barium, as also in finding its atomic weight to be near 224, which permits us to complete the periodic system of elements by placing radium in the second group, in the 12th row, in which we have already thorium and uranium, the ores of which are possessed of radio-activity.[2]

"As to argon and its congeners—neon, krypton, and xenon—these simple gases, discovered by Ramsay, differ from all the known elements in that, up till now, notwithstanding the most varied attempts, they could not be brought into combination with any other substance, or with each other. This gives them a separate place, quite distinct from all other known elements in the periodic system, and induces us to complete the system by a new separate group, the group zero, which precedes group i., the representatives of which are hydrogen, lithium, sodium, and so on.

"The placing of these elements in a new group is fully supported by the atomic weights which are deduced for these gases on the basis of their densities, if we admit that the molecule of each of them contains but one atom.

1 "About this resemblance between argon and helium and the substance of the world's ether I have already written in a separate article entitled 'An Attempt at a Chemical Comprehension of the Ether,' in the review *Messenger and Library of Self-Education*, in the first four numbers of 1903. This article was translated into German in the *Prometheus* of 1903 by M. Tshulok, and into English by M. Kamenskiy under the title 'A Chemical Conception of the Ether' (Longmans, Green and Co., London, 1904). I must, however, remark that the German translation is a complete one, but that the editors of the English translation have omitted the introductory general philosophical remarks about the fundamental distinction between substances (masses), forces (energy), and spirit. This omission deprives the article of the realistic meaning which I intended to give it by introducing ether into the system of elements."

2 "Some later researches lead us to believe that the atomic weight of radium is slightly above the figure found by Madame Curie, but it seems to me that it still remains doubtful whether the conclusion of Madame Curie has to be altered."

Thus, helium must be placed before lithium, and argon before potassium, as is seen from the table, into which radium has also been introduced. In this table there are, in the group zero, two unknown elements, x and y, which have been introduced for two reasons: first, because in the corona of the sun, above the region of incandescent hydrogen, there has been noticed an element which has an independent spectrum, and therefore is named coronium; and although it is yet unknown (helium was also first characterised by Crookes as an element, on account of the independence of its spectrum), it must have a density, and consequently an atomic weight, both smaller than those of hydrogen (in the table, this element is marked as y); and secondly, because there is no reason to believe that the system of elements is limited in the direction of the lightest ones by hydrogen. The presence of the elements x and y in the group zero makes us think that the elements which correspond to these positions in the system will be distinguished by the absence, in a high degree, of the capacity of chemical combination—a property which belongs also, as has been already pointed out, to helium, argon, and their analogues.

"The same property must be attributed to the substance of the ether, which must possess, moreover, an extremely low density, and consequently a very great rapidity of motion of its molecules, in order to have the possibility of escaping from the spheres of attraction, not only from the atmosphere of the earth, but also from the atmospheres of our sun and other suns the masses of which are greater than that of ours. The researches concerning the double stars prove that the masses of the stars which we know do not exceed the mass of our sun more than thirty-two times, while in other cases they are equal to it; therefore, if we attribute to the ether the properties of gases, we must admit, on the basis of the kinetic theory of gases, that its specific gravity must be very much smaller than the specific gravity of hydrogen. In order that the ether may escape from the sphere of attraction of stars the mass of which is fifty times greater than the mass of the sun, it must, while it chemically resembles argon and helium, have an atomic weight not more than 0·000 000 000 053 (and a density, in relation to hydrogen, half as large, as I have proved in the above mentioned article on ether). The very small value of this figure already explains why there is little hope of isolating the substance of the ether in the near future, as it also explains why it penetrates all substances, and why it is condensed in a small degree, or collects in a physicomechanical way, round ponderable substances—being mostly condensed round such immense masses as that of the sun or of stars.[1]"

Row:	Group zero	Group I.	Group II.	Group III.	Group IV.	Group V.	Group VI.	Group VII	Group VIII.
0	x								
1	y	H=1·008							
2	He=4·0	Li=7·03	Be=9·1	B=11·0	C=12·0	N=14·04	O=16·0	F=19·0	
3	Ne=19·9	Na=23·05	Mg=24·1	Al=27·0	Si=28·4	P=31·0	S=32·06	Cl=35·45	
4	Ar=38	K=39·1	Ca=40·1	Sc=44·1	Ti=48·1	V=51·4	Cr=52·1	Mn=55·0	Fe=55·9 Co=59 Ni=59 (Cu)
5		Cu=63·6	Zn=65·4	Ga=70·0	Ge=72·3	As=75·0	Se=79	Br=79·95	
6	Kr=81·8	Rb=85·4	Sr=87·6	Y=89·0	Zr=90·6	Nb=94·0	Mo=96·0	—	Ru=101·7 Rh=103·0 Pd=106·5 (Ag)
7		Ag=107·9	Cd=112·4	In=114·0	Sn=119·0	Sb=120·0	Te=127	I=127	
8	Xe=128	Cs=132·9	Ba=137·4	La=139	Ce=140	—	—	—	— — — (—)
9		—	—	—	—	—	—	—	
10	—	—	—	Yb=173	—	Ta=183	W=184	—	Os=191 Ir=193 Pt=194·9 (Au)
11		Au=197·2	Hg=200·0	Tl=204·1	Pb=206·9	Bi=208	—	—	
12	—	—	Rd=224	—	Th=232	—	U=239	—	

In conclusion, Mendeléeff indicates that while the conception of the chemical elements is connected in the most intimate way with the generally received teachings of Galileo and Newton about the mass and the ponderability of matter, as also with the teaching of Lavoisier concerning the indestructibility of matter, "the conception of the ether originates exclusively from the study of phenomena and the need of reducing them to simpler conceptions. Amongst such conceptions we held for a long time the conception of imponderable substances (such as phlogiston, luminous matter, the substance of the positive and negative electricity, heat, &c.), but gradually this has disappeared, and now we can say with certainty that the luminiferous ether, if it be real, is ponderable, although it cannot be weighed, just as air cannot be weighed in air, or water in water. We cannot exclude the ether from any space; it is everywhere and penetrates everything, owing to its extreme lightness and the rapidity of motion of its molecules. Therefore such conceptions as that of the ether remain abstract, or conceptions of the intellect, like the one which also leads us to the very teaching about a limited number of chemical elements out of which all substances in nature are composed."

[1] "It is worth noting that all the incandescent, self-luminous celestial bodies are immense as regards their masses, in comparison with the cooler bodies like the earth or the moon; perhaps this depends upon the distribution of the ether, which is condensed precisely round such very big masses as the sun and the stars. It is also worth noticing that the atomic weights of radium, as also of thorium and uranium, are very great in comparison with those of the other elements."

WELSH CONFERENCE ON THE TRAINING OF TEACHERS.

THE Welsh National Conference on the Training of Teachers was held in Shrewsbury on November 10 and 11, and although no special reference was made to science teaching, still the subject of education is now in a fair way to be considered a science, since it has been included as a section of the British Association.

The conference was convened by the Central Welsh Board and the University of Wales, and in addition to these bodies, representatives attended from every county education authority in Wales, from every type of educational institution, from the National Executive of Welsh Councils and from all the associations of masters and mistresses. Upwards of 200 delegates attended in all, most of whom remained throughout all four sessions.

At the first session, which was devoted to "The Special Aspect of the Problem of Training Presented in Wales,"

Principal Griffiths, vice-chancellor of the University of Wales, presided, and in his opening address submitted the points which it was most important that the conference should decide. Briefly they were these: What were the real demands of the Principality, and how far were they met by existing institutions? Was Wales to import the shortage of teachers, or to increase her own production? In what manner could the schools be best utilised as training grounds without injuring the schools? and should local education authorities undertake the training of secondary teachers? To these questions no uncertain answer was suggested, although the conference abstained from passing formal resolutions until an opportunity had been accorded the members to consider the verbatim report, which it was decided to publish at an early date.

At the second session Mr. Lloyd George, M.P., presided, and a paper was read by Lord Stanley of Alderley, chairman of the Anglesea Education Committee, and late chairman of the London School Board, on "The Point of View of the Local Authorities." The debate was opened by Mr. S. J. Hughes, county alderman of Glamorganshire. Both Lord Stanley and Alderman Hughes emphasised the paramount importance of training for the elementary school teacher. In summing up the debate, Mr. Lloyd George replaced the sword by the trowel, and emphasised the need for additional accommodation and for subsidising the buildings and the staffs. Enthusiasm was required, he said, to meet the increased burden on the rates, but he believed that the enthusiasm would be forthcoming. At this stage the only resolution of the conference was passed. This was moved by Principal Griffiths, and asserted "That it is the duty of the Principality to undertake the training and supply of teachers sufficient to meet the requirements of the Principality."

At the third session, which was presided over by Sir John Gorst, "The Special Aspects of the Problem of the Training of Elementary Teachers" was considered, a paper being read by Mr. T. John, vice-president of the National Union of Teachers. The experiments already being tried in the utilisation of the intermediate schools of Wales for the training of pupil teachers were described in detail, but the general opinion of the conference was unmistakable—that any half-time system should be a temporary expedient only.

As regards the question of the concurrent instruction of primary and secondary teachers, it was agreed that it is necessary for the separation of the primary teacher's professional training from his general education, and that under certain conditions it is possible and desirable that primary and secondary students should be trained together. The important question of the further training of those acting teachers whose qualifications are incomplete was introduced by Mr. Badger, director of higher education for Monmouthshire.

The relations between the various qualifying examinations were considered, and there was practical unanimity that matriculation should be a condition of entering the primary training departments of the three university colleges of Wales.

Mr. Humphreys Owen, M.P., chairman of the Central Welsh Board, presided over the fourth session, which was devoted to the "Special Aspects of the Problem of Secondary Training." Two papers were read, by Miss E. P. Hughes, late principal of the Cambridge Training College for Secondary Teachers, and Mr. Trevor Owen, Swansea, who acted as the official spokesman of the Association of Welsh County Schoolmasters. The conference was decidedly of opinion that secondary training should be post-graduate and completely differentiated from the degree course, but that the training college should be essentially attached to the university college. Representatives of the Association of Assistant Masters also addressed the conference and endorsed the views expressed by the readers of the papers.

There can be no doubt that the ultimate result of the conference will be far-reaching and beneficial. The interchange of ideas always makes for good, and it is not too much to hope that from the deliberations there may be devised a scheme which will be workable for all parts of the Principality, and will in time produce a supply of fully trained teachers of all grades, which, like her system of secondary education already established, will be a lasting and tangible proof of the enthusiasm of the Welsh people for education.

THERAPEUTIC BACTERIAL INOCULATION.[1]

ALTHOUGH the majority of diseases are produced directly or indirectly by the invasion of microbes, it has come to be generally recognised that the soil in which they grow plays a cardinal part in determining the ultimate effect or fate of the microbe. The finding of a pathogenic microbe, and even the accessory disposing factors of a disease, are, however, after all only the beginnings of the greater problem which is the end and aim of all medical science, viz. the cure of the disease.

To attack the causal agent is manifestly a solution of the problem, and this was the method originally advocated by Lister, who may be regarded as the founder of the doctrine of the ætiological curative principle. Experience has, however, shown that the attempt to destroy by means of ordinary chemical poisons the microbes in the living body is fraught with danger, for long before the protoplasm of the microbe is destroyed the cells of the body are irreparably damaged. Internal antiseptic therapy is a thing of the past. To-day we must rely on the stimulus produced by bacteria in the body whereby the cells of the latter elaborate substances which are antagonistic to these same bacteria. These substances—germicidal in the widest sense of the word—differ considerably in their mode of action. Some neutralise the bacterial poisons, others produce a solution—a lysis—of the bacteria. In other cases, again, Metchnikoff claims that the destruction takes place by a kind of digestion in the interior of certain cells of which the chief representatives are the wandering corpuscles of the blood.

The inoculation of a living microbe for the purposes of prophylaxis dates from the time of Edward Jenner, whose work was widely extended by Pasteur. It is not even necessary to use living bacteria, dead bacteria being likewise capable of conferring immunity. In any case, with the exception of diphtheria antitoxin, previous attempts have aimed at prevention rather than cure. The authors of the papers before us are the first who have utilised bacterial inoculations as a curative agent. Dr. A. E. Wright, late professor in the Army Medical School, is already widely known for his method of the preventive inoculation against typhoid fever—a method which is admitted to have led to a marked diminution of this disease in the British Army. His most important work, however, has been the discovery of therapeutic inoculation. To introduce bacteria into an individual already infected with the same bacteria would at first sight appear to be a paradox, but the results obtained justify the means. By the invention of accurate methods of testing the effects produced in the body by the inoculations, Dr. Wright has been able to demonstrate that the elaboration of protective substances follows a general law, characterised at first by a negative phase and followed by a positive phase in which the protective substances in the blood are increased in quantity.

In a series of papers he has likewise shown that in so-called phagocytosis there is really a cooperation of the cells and fluids of the body, and that in the latter there are substances—opsonins—which in some way or other act upon the microbes and prepare them for subsequent destruction by the leucocytes. This opsonic type of immunity is applicable to a number of diseases, but the present researches show that the mere presence of these opsonins is not sufficient to induce immunity. They must be in the proper place and at the required time if they are to exert their action, and a great deal of art is required on the part of the inoculator to create the most advantageous conditions for his patient. The methods advocated by Prof. Wright are so new that it is difficult to foresee how far they may go, but the striking curative results obtained justify one in prophesying that the time is not so very far distant when the abilities of the physician will be judged by his successes as an immunisator, for it must not be imagined that

[1] "On the Action exerted upon the *Staphylococcus pyogenes* by the Human Blood Fluids, and on the Elaboration of Protective Elements in the Human Organism in response to Inoculations of a Staphylococcus Vaccine." By Dr. A. E. Wright and Capt. Stewart R. Douglas, I.M.S. (*Proc.* Roy. Soc., September, 1904).

"On the Action exerted upon the Tubercle Bacillus by the Human Blood Fluids, and on the Elaboration of Protective Elements in the Human Organism in response to Inoculations of a Tubercle Vaccine." By the same Authors (*Proc.* Roy. Soc., September, 1904).

immunisation consists in the subcutaneous inoculation of some mysterious bacterial fluid prepared in the laboratory. On the contrary, it is a complex process, and it is only with the help of accurate scientific measuring methods that the physician will be able to gauge whether he is helping or injuring his patient. B.

PALÆOZOIC SEED PLANTS.

IT may be doubted if those who are not directly concerned with the study of the vegetable kingdom appreciate the full significance of the distinction which the botanist maintains between plants of seed-bearing and spore-bearing habit. For this reason the recent and important discoveries proving that the seed-bearing habit existed among more than one group of Palæozoic vegetation, discoveries which will form a historical landmark in the study of fossil plants, may not attract the attention which is their due outside the circle of workers on recent and fossil botany.

The seed-bearing habit is, from many points of view, regarded as a far higher stage in plant evolution than that attained by any known member of the vegetable kingdom in which the fertilised megasporangium remains without any integument of the nature of a seed-coat. So far, the botanist has associated the seed habit with two classes of plants, the gymnosperms (Coniferæ, Cycadeæ, &c.) and the angiosperms or flowering plants, and with these alone. It has not been suspected that members assigned to other groups, including the great race of vascular cryptogams (Pteridophyta), had at any period in their evolution attained to this high status. Yet such has recently been shown to be the case.

It is interesting to notice that these discoveries have been mainly due to the British school of palæobotany. Although it has been known for a long period that remains, obviously of the nature of seeds, occur here and there in the sandstones and shales of the Carboniferous period, Carruthers was the first to suggest, in 1872, that some of these fossil seeds may be attributed to the genus Cordaites, an extinct race, of gymnospermous affinities. This conclusion was subsequently confirmed by Geinitz, Grand'Eury, Renault, and other Continental botanists, who have greatly extended our knowledge of this Palæozoic type.

Until recently Cordaites has remained the solitary Palæozoic genus which was known to have attained the seed-bearing habit.

In 1901, however, Dr. Scott published a full description of a Carboniferous cone, Lepidocarpon, of undoubted lycopodian affinities, where integumented megasporangia are found when fully mature, and in which each sporangium contains a single embryo-sac. It has thus become clear that in the history of the lycopodian stock the evolution of seed-bearing members had taken place. More recently other evidence has accumulated which not only confirms this conclusion, but tends to show that Lepidocarpon did not stand alone among lycopods in this respect.

It is to discoveries still more recent of a similar nature, but affecting other lines of descent, that special attention may be directed. They are concerned with a synthetic type of Upper Palæozoic vegetation of great interest, which has become widely known under the name Cycadofilices. More than one genus of this group has now been shown to have reached the seed-bearing status.

The credit of the first discovery of this nature is due to Prof. Oliver and Dr. Scott, who recently published a full account of the seed and the evidence for its attribution in the *Philosophical Transactions* of the Royal Society. The more important conclusion of these authors may be briefly summarised as follows. It has been found that a seed, already recorded by Williamson as *Lagenostoma Lomaxi*, was borne by the fossil plant known as Lyginodendron. The two have not been found in continuity, but the evidence for this conclusion, although in the main indirect, is none the less conclusive. The chief point lies in the identity of the glandular structures found on an organ termed the "cupule," which envelops the seed, with those already known to occur on the stems, petioles and pinnules of Lyginodendron, which are peculiar to this genus among Carboniferous plants.

Within a few months of the earlier record of this remarkable research by Prof. Oliver and Dr. Scott, their main conclusion was confirmed in an unexpected manner by the discovery, on the part of Mr. Kidston, of the seed of another genus of the same group, Medullosa, of which an account has also appeared in the *Philosophical Transactions*. In this case the pedicel of a large seed, of the type known as Rhabdocarpus, was found to bear pinnules identical with those of the frond *Neuropteris heterophylla*, the foliage of a Medullosa.

Here absolute continuity, an extremely rare circumstance among fossil plants, exists between a foliar and a reproductive organ.

Further evidence, but more inconclusive and indirect, also exists, but space forbids any notice here. Attention may, however, be directed to an interesting and suggestive communication published by M. Grand'Eury in the *Comptes rendus* during the present year on the same subject.

The discoveries under discussion have made it clear that at least two genera of the Cycadofilices possessed the seed-bearing habit, and evidence is also available which suggests that Lyginodendron and Medullosa did not stand alone in this respect.

Prof. Oliver and Dr. Scott have concluded that "the presence in the Palæozoic flora of these primitive, Fern-like Spermophytes, so important as a phase in the history of evolution, may best be recognised by the foundation of a distinct class which may suitably be named Pteridospermeæ." This suggestion would seem to be a happy one, even though it may eventually involve the absorption of the whole group now familiar as the Cycadofilices.

In connection with these researches of Prof. Oliver, Dr. Scott, and Mr. Kidston, many further points of interest, and in some cases of criticism, might be discussed, but it must suffice here to direct attention to one or two valuable clues which these discoveries afford. The phylogeny of the cycads, a race with a great past, and still existing though in greatly diminished numbers, is in its main outlines now clear. There can be little doubt that the cycads are sprung from this same pteridospermous stock, which in its turn originated from a truly fern-like ancestor.

In the investing envelope of the young seed of Lagenostoma, which Prof. Oliver and Dr. Scott have spoken of as the "cupule," it is not improbable that homologies may eventually be recognised with protective structures existing among members belonging to other lines of descent, which may have great value as a contribution to other phylogenetic problems.

In conclusion, the existence of the seed-bearing habit among certain members of three out of the six great groups of Upper Palæozoic times raises the interesting speculation whether other groups may not eventually be found to have attained to the same status. The Calamites, the representatives of the Equisetales, are at present above any real suspicion in this respect, yet it would now be hardly surprising if further discoveries revealed the existence of seed-bearing members in this group, although it is by no means safe to assume that the seed-bearing habit must necessarily have existed in any group. E. A. N. ARBER.

ANTHROPOLOGICAL NOTES.

THE *Reliquary and Illustrated Archaeologist* for October contains, as is usual with this journal, interesting and well illustrated articles, among which may be noted one on "the funambulist," or rope-walker, by Mr. Arthur Watson; some Norman and pre-Norman remains in the Dove-Dale district, by Mr. G. le Blanc Smith; medallic portraits of Christ in the sixteenth century, by Mr. G. F. Hill; a carved bone of the Viking age, by Mr. J. Romilly Allen.

All who are interested in primitive technology will welcome the new instalment of Dr. Walter E. Roth's monograph on North Queensland ethnography. *Bulletin* No. 7 deals with domestic implements, arts, and manufactures, and is illustrated by twenty-six plates containing 250 figures. Dr. Roth not only describes the objects in daily use of the Queensland blacks, but, what is of very much greater importance, he usually describes how and of what they are made. Of especial interest and importance is his description of the manufacture of stone implements. He says:—

"I am afraid that too much importance has been hitherto attached to the differentiation of stone-celts into axes, adzes, wedges, scrapers, &c.: the savage certainly does not recognise the fine distinctions embodied on the labels attached to these articles in an ethnological museum. . . . The actual manufacture of a celt is now a lost art in Queensland. . . . The original celt in its simplest form is a water-worn pebble or boulder, an adaptation of a natural form; otherwise, it is a portion removed from a rock, &c., *in situ*, either by fire, indiscriminate breakage or flaking."

A record of a careful excavation of Jacob's Cavern, McDonald County, Missouri, by Messrs. Charles Peabody and W. K. Moorehead, is given in *Bulletin* i., department of archæology, Phillips Academy, Andover, Mass. The implements are of well known types, and nothing suggestive of Palæolithic culture was discovered; it is possible that the cave-dwellers were different from the Osages and from the lower Mississippi tribes. The paper is illustrated by eleven plates. The Phillips Academy is to be congratulated on its activity.

An interesting and well illustrated *résumé* of the recent archæological discoveries in Crete is given by M. S. Reinach in *l'Anthropologie* (Tome xv., Nos. 3-4, p. 257). The author tentatively proposes the following chronology of the development of the Cretan civilisation:—(1) 4500 (at least) to 2800, Neolithic period. Black pottery, with angular designs and no spirals; numerous stone vessels; no metal; rudimentary figurines of burnt clay. (2) 2800 to 2200, period of Kamares or Minoan I. About 2800 first certain contact with Egypt (twelfth dynasty); introduction of copper and bronze into Crete; painted pottery derived from Neolithic pottery. (3) 2200 to 1900, period of transition or Minoan II. Building of first palace. Continuation of relations with Egypt and commercial dealings with the islands of the Archipelago, notably with Melos. (4) 1900 to 1500, culmination of the period of Kamares or Minoan III. Building of the second palace; great development of ceramics, glyptics, and painting. An artist of Knossos went to Phylakopi, in Melos, and executed the "flying-fish fresco"; the linear Cretan writing occurs on Melian pottery. An insular confederation (?) took possession of Knossos and there established a new dynasty (?). (5) 1500 to 1200, Mycenæan period. Ceramics with zoomorphic and curvilinear designs. The centre of civilisation passed to the Peloponnesos; decadence and abandonment of the palace. The last king of the Minoan dynasty, Idomeneus, left Crete about 1200 for Italy, and founded Salentium; shortly afterwards the Dorians conquered Crete, and the island entirely retrogressed into barbarity.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The report of the studies and examinations syndicate on the previous examination, in which it is proposed that a modern language may be substituted for Greek or Latin, will be discussed in the Senate House on December 1.

Dr. H. F. Baker, F.R.S., St. John's, and Mr. F. H. Neville, F.R.S., Sidney, have been appointed members of the general board of studies. Prof. J. J. Thomson, F.R.S., has been appointed a manager of the Gerstenberg studentship in moral philosophy for students of natural science.

Dr. Myers has been appointed demonstrator of experimental psychology.

The Isaac Newton studentship in astronomical physics and optics, value 200*l.* a year for three years, will be vacant next term. Candidates must be B.A.'s of the university, and under twenty-five years of age on January 1, 1905. Application is to be made to the Vice-Chancellor before January 26.

Additional benefactions to the university, amounting to some 3500*l.*, have been paid or promised since February of the present year. A considerable number are ear-marked for the endowment of a Huddersfield lectureship in special pathology.

Two Walsingham medals in biology have been awarded this year, one to Mr. R. P. Gregory, fellow of St. John's College (for botany), and one to Mr. K. Lucas, fellow of Trinity College (for physiology).

NEW buildings of the Borough Polytechnic Institute, including buildings for engineering, building trades, domestic economy, &c., are to be opened as we go to press by Mr. J. W. Benn, M.P., chairman of the London County Council.

LORD REAY will deliver the prizes at the Northampton Institute for the session 1903-4 on Friday, December 9, at 8 o'clock. The prize distribution will be followed by a conversazione, which will be continued on Saturday, December 10.

DR. FREDERIC ROSE, His Majesty's Consul at Stuttgart, and the author of a series of diplomatic and consular reports on technical instruction in Germany, has been elected assistant educational adviser to the Education Committee of the London County Council.

THE committee in charge of the fund for the development and better equipment of the science schools in Trinity College, Dublin, has announced that 15,886*l.* has now been subscribed towards the 78,000*l.* necessary for the annual up-keep of the new schools. It will be remembered that Lord Iveagh offered to provide the sum of 34,000*l.* required to erect the new buildings if the amount required for up-keep were obtained by public subscription. The committee, in making an earnest appeal for further subscriptions, points out that the next most urgent need of the university is the development of the school of botany and plant physiology.

IT may be taken as indicative of the widespread interest in higher education among the Welsh people that large sums of money are contributed in a great number of small amounts towards the expenses of the university colleges. For instance, in the preliminary list of subscriptions, paid or unpaid, towards the permanent buildings fund, published in the calendar of the University College of North Wales for the session 1904-5, we notice that more than 6500*l.* is made up of amounts under five pounds, and, in addition to this, there are more than two hundred gifts of five guineas or five pounds. The total amount of subscriptions up to the present towards the permanent buildings fund reaches 27,190*l.*

THE Education Committee of the County Council of the West Riding of Yorkshire arranged last summer for the attendance of a group of art-masters from the schools in their administrative area to attend for six weeks at the School of Industrial Arts, Geneva. The committee has now published extracts from the report received from the administrator of the Geneva school on the work of the Yorkshire teachers, and a summary of the reports submitted by the art-masters who studied at Geneva. The teachers seem to have benefited greatly by their visit, and there can be little doubt that a first-hand acquaintance with Continental methods is of great value to English teachers. One interesting way in which scientific observation may be rendered useful in art instruction comes out in the report of one of the visiting masters, who writes of the Geneva School of Industrial Arts that: "Another very useful adjunct is a garden where Nature is allowed to have very much of her own way. Here the form and colour of plants and flowers and their growth at various stages can be carefully and leisurely studied."

SPEAKING at the Birmingham Municipal School on Tuesday, Mr. Alfred Mosely referred to some lessons taught by the American educational system. He remarked that America differs from us in an intense belief in education, and the realisation by manufacturers of the value of the thoroughly trained college student in their factories. We are face to face with a condition of things which is somewhat alarming. A scientific education has become an absolute necessity if we are to hold our place industrially. We have an Empire such as those who have not travelled do not realise, an Empire teeming with natural resources in every direction, merely awaiting the skilled hands of the mechanic and farmer to develop them. What we have in Canada and our other colonies makes the United States pale by comparison, but the United States have learnt to develop their resources, while we have been quarrelling over the village pump. It is Mr. Mosely's intention at an early date to approach some of the steamship companies to see whether facilities can be arranged for some school teachers to visit the United States and observe what is done there.

SOCIETIES AND ACADEMIES.

LONDON.

Chemical Society, November 3.—Prof. W. A. Tilden, F.R.S., in the chair.—The following papers were read:—Studies on the dynamic isomerism of α- and β-crotonic acids, part i.: R. S. **Morrell** and E. K. **Hanson.** Preliminary experiments on the freezing points of mixtures of the two acids furnish no evidence as to the existence of a compound of α- and β-crotonic acids between 100° and 168°, and between 15° and 71°·9.—The constitution of nitrogen iodide: O. **Silberrad.** In the interaction of zinc ethyl with nitrogen iodide it was found that trimethylamine was produced. This confirms Chattaway's view that the iodide has the constitution $NH_3:NI_3$.—The available plant food in soils: H. **Ingle.** Extraction with a 1 per cent. solution of citric acid for seven days renders a soil much less fertile, especially at first, but chemical changes in such soil, during the growth of the plants, gradually render it again capable of supplying plant food.—The basic properties of oxygen: compounds of the ethers with nitric acid: J. B. **Cohen** and J. **Gatecliff.** It is shown that with aliphatic ethers unstable compounds of the type X_2O,HNO_3 are formed.—Note on the influence of potassium persulphate on the estimation of hydrogen peroxide: J. A. N. **Friend.** It is shown that a secondary reaction, represented by the following equation,

$$H_2O_2+K_2S_2O_8=K_2SO_4+H_2SO_4+O_2,$$

probably takes place in addition to the main reaction.—The influence of sunlight on the dissolution of gold in aqueous potassium cyanide: W. A. **Caldecott.**—The fractional hydrolysis of amygdalinic acid, *iso*-amygdalin: H. D. **Dakin.**—The effect of anhydrides on organo-magnesium bromides, part i., the action of phthalic anhydride on magnesium α-naphthyl bromide: S. S. **Pickles** and C. **Weizmann.**—The combustion of ethylene: W. A. **Bone** and R. V. **Wheeler.** The principal results of these experiments are as follows:—(1) there is no preferential combustion of either carbon or hydrogen; (2) formaldehyde is the most prominent intermediate oxidation product; (3) there is no separation of carbon or liberation of acetylene.—The decomposition of methylcarbamide: C. E. **Fawsitt.** The decomposition of methylcarbamide by acids is due to a transformation of the methylcarbamide into methylamine cyanate, which is subsequently decomposed by the acid.—Position isomerism and optical activity; the methyl and ethyl esters of di-*o*-, -*m*-, and -*p*-nitrobenzoyltartaric acids: P. F. **Frankland** and J. **Harger.** The authors describe the preparation and properties of the six esters in question.—The action of nitrogen sulphide on organic substances, part ii.: F. E. **Francis** and O. C. M. **Davis.**—Reduction products of αβ-dimethylanhydracetonebenzil, and condensation products of benzaldehydes with ketones: F. R. **Japp** and W. **Maitland.**—Interaction of sodium phenylglycidate with phenylhydrazine: F. R. **Japp** and W. **Maitland.**—α-Benzoyl-β-trimethacetylstyrene: F. R. **Japp** and W. **Maitland.**—Olefinic ketonic compounds: S. **Ruhemann.**—Δ^{α}-Oleic acid: H. R. **Le Sueur.**—Action of magnesium alkyl halides on derivatives of camphor: M. O. **Forster.**—Sulphonchloroalkylamides: F. D. **Chattaway.**

Linnean Society, November 3.—Prof. W. A. Herdman, F.R.S., president, in the chair.—Mr. G. Claridge **Druce** showed specimens of a new British grass, *Koeleria valesiaca*, Gaud., which he had found in the herbarium of Dillenius at Oxford, and recently re-found in the original locality at Brent Down, Somersetshire.—The Rev. John **Gerard**, S.J., brought specimens of a proliferous plantain (*Plantago major*) from the neighbourhood of Clitheroe, Lancashire.—Mr. Frank **Crisp** brought for exhibition a flower of *Schubertia graveolens*, Lindl., an asclepiad, which, deprived of its corolla and with a portion of its calyx cut away, viewed from the side, presented the genitalia in the shape of a skull.—A note on some points in the structure of the gill of the Ceylon pearl-oyster: the **President.**—Notes on the "sudd" formation of the Upper Nile: A. F. **Broun.** The author gives a list of the plants forming the mass of vegetation, which, favoured by the silt brought down by the White Nile, helps to block the shallow channels.—Bryozoa from near Cape Horn: A. W. **Waters.** The paper deals with specimens which were collected by the French "Mission scientifique du Cap Horn," but were not mentioned by Jullien in his report on the "Bryozoaires" of that expedition, published in 1888. From this material, which Jullien had presumably not handled, Mr. Waters adds twenty-eight species to the original list of fifty-six. He gives further particulars in regard to some of those named by his predecessor, and points out that eight species established by Jullien had been already described under other names. He rectifies two erroneous identifications, enlarges the range of distribution for several species, and for six of them calls to mind that they were first discovered by the *Challenger*.

Mathematical Society, November 10.—Prof. H. Lamb, president, in the chair.—The council and officers for the ensuing session were elected. They are as follows:—president, Prof. Forsyth; vice-presidents, Prof. Burnside, Prof. Elliott, Prof. Lamb; treasurer, Prof. Larmor; secretaries, Prof. Love and Mr. Grace; other members of council, Mr. Berry, Mr. Campbell, Dr. Glaisher, Dr. Hobson, Major MacMahon, Mr. Mathews, Mr. Western, Mr. Whittaker, Mr. A. Young.—Prof. Forsyth having taken the chair, Prof. **Lamb** delivered an address on deep-water waves. He reviewed the theory of the waves produced on deep water by a local disturbance of the surface. The theory developed independently by Poisson and Cauchy had often been regarded as obscure, and it had never been interpreted completely. The problem has a deeper significance in that it offers perhaps the simplest example of the propagation of waves in a dispersive medium, and was the origin of the theory of group velocity, which has so many applications in various branches of physics. After tracing the history of the problem, the author proceeded to disengage the essential results of the theory from the clouds of analysis in which they had been involved; he pointed out the connection of the analytical results with the analysis which was used at a later date for the investigation of the phenomena of diffraction; he traced the forms of the waves due to a local initial elevation both at considerable and at small distances from the source of disturbance; and he pointed out the significance of the results when interpreted by means of modern notions concerning waves of approximately simple harmonic type and the propagation of groups of such waves. Finally, he discussed the solution of the problem of waves generated by a local and periodic variation of pressure.—The following papers were communicated:—Note on the application of the method of images to problems of vibrations: Prof. **Volterra.** It is shown how to obtain by means of the method of images a complete solution of the problem of vibrations of a membrane, and it is pointed out that although the train of images may be infinite, yet the number of terms in the solution is finite.—The zeros of certain classes of integral Taylor's series, two papers: G. H. **Hardy.** The nature of the zeros of some particular classes of functions, allied to the exponential function, is determined with much greater precision than can be attained by any of the known general theorems. If $\phi(n)$ is an integer when n is an integer, and the increase of $\phi(n)$ is regular and sufficiently rapid, there are exactly $\phi(n)$ zeros of $\Sigma\frac{x^{\phi(n)}}{\phi(n)!}$ within the circle $|x|=\phi(n)$, and their positions can be determined very precisely. In the second paper similar investigations are given for other functions of which $\Sigma\frac{x^n}{(np+1)^n n!}$ is an example.—On the reducibility of covariants of binary quantics of infinite order: P. W. **Wood.** The paper contains the conditions that any covariant linear in the coefficients of each of δ binary quantics of infinite order should be expressible in terms of products of covariants of lower total degrees. The reducibility of covariants of degree 4 is determined completely, and certain classes of reducible covariants of degree δ and weight $\geqslant(2^{\delta-1}-1)$ are discussed.—The linear difference equation of the first order: Rev. E. W. **Barnes.** The questions to be considered relate to the existence of solutions, their analytical expression, and their place among transcendental functions. These questions are discussed from the point of view of the theory of functions of complex variables, the arguments of the functions which occur in the difference equations being assumed to be complex.—Curves on a conicoid: H. **Hilton.**—Remarks on alternants and continuous groups: Dr. H. F. **Baker.**—Expansions of the

elliptic and Zeta functions of $\frac{3}{8}K$ in powers of q: Dr. J. W. L. **Glaisher.**—Examples of perpetuants: J. E. **Wright.**—Two simple results in the attraction of uniform wires obtained by quaternions: Prof. **Genese.**—A theorem relating to quotient groups: Prof. **Miller.**—On certain classes of syzygies: A. **Young.**

CAMBRIDGE.

Philosophical Society, October 31.—Annual general meeting, Dr. Baker, president, in the chair.—Prof. Marshall Ward, F.R.S., was elected president for the session 1904–5. —On the dimorphism of the English species of Nummulites: J. J. **Lister,** F.R.S. The author gave an account of his examination of the characters of three English species of Nummulites, *N. laevigata* (Brug.), *N. variolaria* (Lam.), and *N. elegans* (Sow.), with respect to dimorphism. It appears that these species, far from invalidating the conclusion that the species of Nummulites are dimorphic, are in complete accord with it.—A problem concerning wood and lignified cell-walls: Prof. Marshall **Ward,** F.R.S. Dr. W. J. Russell some time ago showed that if a block of wood is laid on a photographic plate, and kept in the dark for some time, a photographic image will be found on the plate after ordinary development, although no light has had access; and he has summarised his numerous and important observations in a recent paper in the *Philosophical Transactions*. Since resinous woods were found especially active, Russell suggested that some active body of resin-like nature was the agent concerned, and that hydrogen peroxide was developed. Prof. Marshall Ward's paper describes experiments which were directed to the questions, (1) can this photographic contact-method be utilised to obtain images of thin and microscopic sections of wood? and (2) what other substances, *e.g.* in woods devoid of resin, are active? The author showed photographs, obtained without light, of thin sections of many different kinds of wood, and demonstrated that in most cases resin and allied bodies cannot be the active agents. He also showed that a thin section which gives a very faint image, or even no recognisable image at all, if used dry and untouched, may give a very deep one if soaked in a weak solution of tannin, gallic acid, pyrogallol, &c., and then dried before being placed on the plate. A striking result is obtained if such solution is streaked across the section; the treated streak or figure comes out deep black on a pale ground-work of the part untreated. Xylol, clove oil, tannic acid, and some other bodies are also active. The author thinks that a careful comparative investigation of all kinds of woods might lead to important results regarding that very difficult question, the constitution of lignified cell-walls.—The pine-apple gall of the spruce: note on the early stages of its development: E. R. **Burdon.** The galls are caused by certain Aphidæ belonging to the genus Chermes. The insect drives its proboscis into the bud, and sets up an irritation which results in the young shoot becoming modified into a gall. The early stages of the gall take place whilst the shoot is still enclosed in the winter bud scales. The cells are forced into precocious growth, and a parenchymatous tissue, consisting of swollen cells with vacuolated protoplasm and enlarged nuclei, is formed. The chlorophyll, tannin, resin, resin canals, and secretory cells all disappear, but an abundant supply of starch is laid down which may possibly arise as the ultimate product of the disintegration of the tannin. The chromatin network of the nuclei becomes aggregated into wart-like nucleoli. The mitotic figures appear to be of the usual somatic type, and no indication of heterotypical mitoses has yet been found. There is reason for believing that the ultimate cause is an injection by the insect, and that this injection will cause a gall growth only when it acts on embryonic tissues which are not confined by other lignified or cuticularised tissues.—On certain quintic surfaces which admit of integrals of the first kind of total differentials: A. **Berry.**

MANCHESTER.

Literary and Philosophical Society, November 1.—Prof. W. Boyd Dawkins, F.R.S., president, in the chair.—On alkaline borates: C. H. **Burgess** and A. **Holt,** jun. The authors found that nearly all the glasses obtained by fusing boric anhydride with varying quantities of sodium carbonate could be transformed, wholly or in part, into stable, crystalline forms, which invariably melt at a higher temperature than the glasses from which they were derived. The study of the melting points of these mixtures, and the analyses of the crystals and glasses, point to the probable existence of both sodium metaborate and a further compound containing only a quarter equivalent of sodium. Anhydrous borax itself does not appear to be a definite compound; it is almost a eutectic mixture of the solid solution of the two above mentioned compounds. The glasses appear to be a superfused state of the crystals. The familiar colours of borax beads seem to be due to the formation of a complex sodium ion, and can be changed in tint by increasing or decreasing the amount of alkali present.—Note on the electrolytic preparation of titanous sulphate: W. H. **Evans.** The results show that a low current density, high concentration, and a temperature of about 70° C. are the most favourable for obtaining an efficient yield in this reduction process. Moreover, the author has found that the preparation can be carried out without the use of any diaphragm to separate the anode from kathode chambers of the cell.

DUBLIN.

Royal Irish Academy, November 14.—Prof. R. Atkinson, president, in the chair.—On the discovery of hyæna, mammoth, and other extinct Mammalia in a Carboniferous cavern in the county of Cork: R. J. **Ussher.** After recapitulating the work that has been done in Irish caves, Mr. Ussher described an extensive cavern in county Cork, near Doneraile, in every portion of which that he has examined remains of extinct Mammalia have been found. Mammoths, old and young, have been met with in several places; bears and reindeer were abundant; Irish elk, wolf, and hyæna were also found; the last, identified by Dr. Scharff from a portion of a skull with teeth, is an addition to the Irish fauna. These remains were in red sand beneath a floor of crystalline stalagmite, which was present in the various chambers and galleries.

PARIS.

Academy of Sciences, November 7.—M. Mascart in the chair.—Researches on the desiccation of plants and vegetable tissues: final equilibrium, under average atmospheric conditions: M. **Berthelot.** The rate of loss of moisture is proportional at any instant to the quantity of water remaining in the plant. A further amount of moisture is driven off at 110° C.—On the absolute desiccation of plants and vegetable materials: period of artificial desiccation. Reversibility by atmospheric moisture: M. **Berthelot.**—On the preparation in a state of purity of boron trifluoride and silicon tetrafluoride, and on some physical constants of these compounds: Henri **Moissan.** The boron fluoride was prepared in two ways, by heating a mixture of boric anhydride and calcium fluoride with sulphuric acid, and by direct synthesis from boron and fluorine. After purification, the gas was frozen by liquid air, foreign gases pumped off, and the solid allowed to volatilise. The boron fluoride melted at −127° C. and boiled at −101°. Silicon fluoride, purified in a similar manner, melts at −97°, and passes into the gaseous state without melting. The experiments establish the physical identity of BF_3 and SiF_4 prepared synthetically with the compounds prepared by the ordinary chemical methods.—On the nature of *charriage*: Ed. **Suess.** —Remarks by Michel **Lévy** on the preceding paper.—On a hyperelliptic surface: M. **Traynard.**—On the complementary geodesic triangulations in the higher parts of the French Alps: P. **Helbronner.**—On a new mode of constructing aërial helices: Ch. **Renard.** The helices described are 2·5 m. in diameter, and are perfectly rigid when rotated by power, although their weight is only 3 kilograms. —On explosions in boilers: L. **Lecornu.**—Retrograde diffusion in electrolytes: E. **Bose.** The author points out that the results obtained experimentally by Thovert were predicted by Abegg and Rose on Nernst's theory.—On the estimation of temporary radio-activity for its therapeutic utilisation: Th. **Tommasina.**—The proof of a radio-activity peculiar to living beings, vegetable and animal: Th. **Tommasina.**—The action of low temperatures on colouring matters: Jules **Schmidlin.** An alcoholic solution of rosaniline chlorohydrate shows a clear diminution in the intensity of the red colour, and at the same time developes a fine greenish-yellow fluorescence.—Heats of combustion of

triphenylmethyl and some derivatives of triphenylmethane: Jules **Schmidlin.**—The preparation of iodide of gold by the action of iodine on gold: Fernand **Meyer.** The iodide AuI can be obtained by the direct action of iodine upon gold at temperatures between 50° and 100°. Below 50°, or above 200°, there is no action. In the presence of water in a closed vessel iodine gives with gold the same aurous iodide.—On a yttrium earth near to gadolinium: G. **Urbain.** An attempt to isolate an element characterised by the band $\lambda=488$.—On β-bromobutyric acid: M. **Lespieau.** The amide of this acid is obtained by saturating allyl cyanide with hydrobromic acid in the cold. A crystalline mass separates, which, when dissolved in concentrated hydrobromic acid solution, deposits white crystals of the amide.—The oxidation of acetol: André **Kling.**—On the formation of formaldehyde during the combustion of tobacco: A. **Trillat.** The experimental results show that aldehydes are formed during the combustion of tobacco, notably formaldehydes. The toxic effects, however, are modified by the fact that these aldehydes immediately combine with the nitrogenous bases given off at the same time.—On the germination of the spores of *Atrichum undulatum* and *Hypnum velutinum*, and on their nutrition in sterilised liquid media: Paul **Becquerel.**—On the development of the kidney and Leydig's gland in the Elasmobranchs: I. **Borcea.** The kidney of the Elasmobranchs has the same value as that of the higher vertebrates.—The influence of the feeding on the length of the intestine of the larvæ of *Rana esculenta*: Émile **Yung.**—On an infectious disease of horses, with alterations in the bones, observed at Madagascar: MM. **Charon** and **Thiroux.**—On the general structure of the Tyrolese Alps west of the Brenner Railway: Pierre **Termier.**—Modifications undergone by the nutritive exchanges in skin disease: A. **Desgrez** and J. **Ayrignac.**

NEW SOUTH WALES.

Royal Society, September 7.—Mr. C. O. Burge, president, in the chair.—Notes on the theory and practice of concrete-iron constructions: F. M. **Gummow.** The author outlined the theory from the present standpoint of scientific research, and after reviewing the principal applications, concluded his paper by giving particulars of a test of concrete-iron plate beams, carried out on a large scale.—Further experiments on the strength and elasticity of reinforced concrete: Prof. W. H. **Warren.** The author stated that the paper consisted of an experimental investigation of the physical properties of Portland cement mortars and concrete when reinforced with steel.

Linnean Society, September 28.—Dr. T. Storie Dixson, president, in the chair.—Monograph of the Australian Cicadidæ: Dr. F. W. **Goding** and W. W. **Froggatt.** Descriptions of all the Cicadidæ attributed to Australia, amounting to 115 species, comprised in 21 genera, are given. In connection with the geographical distribution of the species it may be mentioned that though many are strictly confined to the coastal forests of eastern Australia, others are found sporadically over a very large area, reappearing in widely separated districts if the suitable class of country presents itself. For example, *Tibicen willsi*, Dist., described from Rockhampton, ranges up the Queensland coast to Townsville, occurs also at Bourke, N.S.W., and reappears at King's Sound, N.W.A. Indo-Malayan affinity is indicated by the occurrence of the genera Gæana and Huechys.—Notes on Neuroptera, with descriptions of new species: W. W. **Froggatt.**—Ngarrabul and other aboriginal tribes, part ii., distribution of the tribes: J. **MacPherson.** The distribution of twenty-four tribes in north-east New South Wales and South Queensland, in accordance with the languages spoken and as gleaned from Ngarrabul sources of information, is discussed and mapped.—Notes on the native flora of New South Wales, part i., the Tumbarumba and Tumut districts: R. H. **Cambage.** These notes comprise observations on the conspicuous vegetation of the country between Wagga, Tumbarumba, Tumut, and Gundagai during the drought of 1903, and serve to show the striking differences between the flora of the low country round Wagga (600 feet above sea-level) and that of Laurel Hill or Bago, near Tumbarumba (about 3300 feet), where the vegetation presents a recognisable Tasmanian facies.

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 17.

ROYAL SOCIETY, at 4.30.—Air Resistance Encountered by Projectiles at Velocities up to 4500 Feet per Second: A. Mallock, F.R.S.—Theory of Amphoteric Electrolytes. Part II.: Prof. J. Walker, F.R.S.—Enhanced Lines of Titanium, Iron, and Chromium in the Fraunhoferic Spectrum: Sir Norman Lockyer, K.C.B., F.R.S., and F. E. Baxandall.—On the Group IV. Lines of Silicium: Sir Norman Lockyer, K.C.B., F.R.S., and F. E. Baxandall.—The Electrical Conductivity and other Properties of Sodium Hydroxide in Aqueous Solution, as Elucidating the Mechanism of Conduction: W. R. Bousfield, K.C., M.P., and Dr. T. Martin Lowry.—On the Wetting of Cotton by Water and by Water Vapour: Prof. D. Orme Masson, F.R.S.

LINNEAN SOCIETY, at 8.—On the Structure of the Stems of Plants: Lord Avebury, F.R.S.—Observations on Undescribed or Little Known Species of Membracidæ: G. B. Buckton, F.R.S.

FRIDAY, NOVEMBER 18.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Impact Tests on the Wrought Steels of Commerce: A. E. Seaton and A. Jude.

EPIDEMIOLOGICAL SOCIETY, at 8.30.—The Inauguratory Address on the Epidemiological Aspects of Industrial Diseases: the President, Dr. Whitelegge, C.B.

TUESDAY, NOVEMBER 22.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Distribution of Electrical Energy: J. F. C. Snell.

WEDNESDAY, NOVEMBER 23.

GEOLOGICAL SOCIETY, at 8.—On an Ossiferous Cavern of Pleistocene Age at Hoe Grange Quarry, Longcliffe, near Brassington, Derbyshire: H. H. Arnold-Bemrose and E. T. Newton, F.R.S.—The Superficial Deposits and Pre-Glacial Valleys of the Northumberland and Durham Coalfield: D. Woolacott.

FARADAY SOCIETY, at 8.—Recent Investigations Bearing on the Theory of Electrolytic Dissociation: Prof. L. Kahlenberg.—The Potential of the Hydrogen-Oxygen Cell: F. J. Brislee.

SOCIETY OF ARTS, at 8.—The Systematic Promotion of British Trade: Ben. H. Morgan.

THURSDAY, NOVEMBER 24.

ROYAL SOCIETY, at 4.30.

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