THURSDAY, MARCH 15, 1906.

TEXT-BOOKS ON PLAIN AND REINFORCED CONCRETE WORK.

(1) *Cements, Limes, and Plasters: their Materials, Manufacture, and Properties.* By E. C. Eckel. Pp. xxxiv+712. (New York: J. Wiley and Sons; London: Chapman and Hall, Ltd., 1905.) Price 25*s.* 6*d.* net.

(2) *Cement and Concrete.* By L. C. Sabin. Pp. x+507. (London: Archibald Constable and Co., Ltd., 1905.) Price 21*s.* net.

(3) *A Treatise on Concrete, Plain and Reinforced.* By F. W. Taylor and S. E. Thompson. Pp. xviii+585. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1905.) Price 21*s.* net.

(4) *Reinforced Concrete Construction.* By A. W. Buel and C. S. Hill. Pp. x+434. (London: Archibald Constable and Co., Ltd., 1905.) Price 21*s.* net.

(5) *Concrete Steel: a Treatise on the Theory and Practice of Reinforced Concrete Construction.* By W. Noble Twelvetrees, M.I.M.E., &c. Pp. xii+218; illustrated. (London: Whittaker and Co., 1905.) Price 6*s.* net.

(1) THIS book gives an exhaustive account of the various processes involved in the preparation of plasters, limes, and cements, and of the examination of these materials both by chemical and by physical tests. It is probably one of the most complete treatises which has been published up to the present day on this subject, and the author justifies the thoroughness of the treatment by statistics in regard to the monetary value of the cementing material annually produced in Europe and America; in the United States the monetary value of cementing materials increased from 21,773,246 dollars in 1900 to 45,607,436 dollars in 1903.

The author classifies cementing materials under two heads, viz. simple cementing materials, which include all those produced by the expulsion of a liquid or gas through the action of heat from a natural raw material, and the setting properties of which are due to the simple re-absorption of the same liquid or gas, and complex cementing materials, which include those cements the setting properties of which are due to the formation of entirely new chemical compounds during manufacture or use. Plasters are first dealt with in group i.; the process of manufacture is explained, statistics are given as to the total production of gypsum, and details of the chemical and other properties of plasters used in building work; one chapter in this section is devoted to the manufacture and properties of lime-sand bricks, which are made by mixing sand, or gravel, with a relatively small percentage of slaked lime.

As the value of Portland cement annually manufactured in the United States is three-fifths of the total value of the output of cementing materials, it is only natural that a very large portion of the book should be devoted to the questions of the manufacture and testing of Portland cement. The quarrying and other preliminary work necessary in order to obtain the raw materials from which Portland cement is made are dealt with in a series of well written and well illustrated chapters. Then follow details of the preparation of the material for the kilns, and of the best methods to employ in burning the cement and in working the kilns; this is the first text-book on this subject in which we have found a complete and detailed account of the construction and working of the modern rotary kiln. The cementing value of Portland cement depends so largely upon the fineness and character of the grinding that the author rightly devotes much attention to a description of the various grinding machines which have been devised for this work. The last portion of the book is devoted to an account of the physical and chemical tests usually employed in testing Portland cement, and the rules drawn up in 1904 by the American society for testing materials are given in full.

(2) The original investigations which form the basis of this book were made by the author in connection with the construction of the Poe Lock at St. Mary's Falls Canal, Michigan, under the direction of the Corps of Engineers, United States Army. The book is divided into four parts; in the first section a brief account is given of the different cements and limes in ordinary use, and the processes employed in their manufacture; there is a good description of the rotary kilns now often used in making Portland cement.

In part ii. the author deals with the various physical tests usually enforced in examining Portland cement in order to ascertain its quality and its suitability for various purposes, and a series of tables is given of the results of tests made by the author in connection with the works at St. Mary's Falls Canal. In the last chapter of this section the author explains carefully the method adopted at these works for recording the receipt of Portland cement from the manufacturers, the methods adopted for storing it, and for keeping the records of the various tests made from sample barrels selected from each delivery; this chapter will be found very useful as a guidance by any engineer who may have to undertake similar work.

The question of the correct proportion of the various ingredients in concrete, and the methods employed in mixing them, are dealt with in part iii., and a number of tables is given for enabling in any case a determination to be made of the percentage of voids present in broken stone of various classes when broken to varying degrees of fineness; this portion of the book is of an extremely practical nature, and contains a great deal of useful information. The last portion of this section is devoted to the testing of concrete, and the results of a carefully arranged series of tests carried out by the author are given in tabular form. This portion of the book also deals with the question of the determination of the modulus of elasticity of concrete, and with such important points as the

change in volume during the process of setting, resistance to fire, and other matters of a similar nature.

The last section of the book, part iv., is devoted to a description of the various classes of work for which cement concrete is most useful, and the question of reinforced concrete, or concrete-steel, as the author prefers to call it, is taken up. In the last few chapters the methods of applying concrete—both plain and reinforced—in large structures such as subways, arches, reservoirs, retaining walls, dams, &c., are fully explained. The book has a good index.

(3) The whole question of concrete work, both when used by itself and when employed in combination with steel, or reinforced concrete, as it is technically known, is fully dealt with in this elaborate treatise. The first portion of the book is devoted to the properties of Portland and other cements, and includes an interesting chapter which deals with the chemistry of hydraulic cements, and which has been specially written for the book by a chemist, Mr. S. B. Newberry. The authors then deal with the question of the ordinary standard tests of Portland cement, and quote the recommendations of the French Commission of 1893, and of the special committee of the American Society of Civil Engineers, appointed in 1904. There are a number of first-rate illustrations of the various appliances which are needed, and full explanations are given as to the best way of carrying out these standard tests. In addition to the standard tests, special tests, such as those on compression, adhesion, &c., are also discussed. This portion of the book will be found extremely useful for reference purposes.

Two chapters deal with the questions of the method of determining the laws of volumes and voids in concrete work, and the right methods of proportioning the ingredients used in making are explained in detail. The methods described may seem almost too elaborate, but there is no doubt that it pays well when concrete is to be used on a large scale to spend a considerable amount of time and trouble beforehand in determining exactly the best possible mixtures of cement, sand, and broken stone in order to produce the most economical as well as the strongest concrete suitable for the work which has to be carried out.

The authors then begin the subject of reinforced concrete, and, after discussing the values which should be used for the moduli of elasticity of concrete, both in tension and compression, go on to deal with the problem of the moment of resistance of a reinforced beam. The formulæ obtained are fairly simple, and may be said to be approximately correct, since the neglect of the tensile stress taken up by the concrete is perfectly reasonable in designing such beams. It appears to us very inadvisable in our present state of knowledge to attempt to use extremely elaborate formulæ in calculating the strength of reinforced beams, since the values obtained by different experimenters, and even by the same experimenter, for the moduli of elasticity of concrete differ by such large amounts, and the assumption that the stress-strain diagram is a parabolic curve seems to us quite unwarranted by the experimental data available up to the present time.

The authors then give some convenient tables for use in the calculation of the strength of beams and slabs which are continuous over supports, and work out a number of examples to illustrate the use of these tables. In dealing with the mixing of concrete, a number of illustrations is given of the various types of mechanical mixers now used when concrete has to be made on a large scale, including mixers fitted with automatic measuring plants in order to keep the proportions of the various materials absolutely uniform. A special chapter in this section has been written for the book by Mr. R. Feret upon the effect of sea-water upon concrete.

A few chapters then follow on the question of the effect of frost upon concrete, both during the time of depositing the concrete and after the concrete has been deposited, upon the necessary proportions of the various ingredients in order to secure absolute water-tightness in any given mass of concrete, and upon the protection afforded to iron and steel when used in reinforced concrete against fire and rust. The remaining chapters of the book are devoted to details of concrete work in various situations, such as sidewalks of streets, floors and walls of buildings, foundations and piers for bridges, retaining walls, sewers, subways, arches, reservoirs, and tanks, and the most economical method of strengthening such concrete by steel reinforcements. A very good bibliography of the subject, and some appendices dealing with the formulæ for the strength of beams, conclude a very valuable book.

(4) This is a treatise for engineers engaged in the design and construction of works in reinforced concrete, and is based mainly on American practice. The book is divided into three parts; in part i., for which Mr. Buel is responsible, after a brief explanation of the properties of cement concrete and steel, the methods of calculation are dealt with; simple formulæ are deduced for the strength of beams, both for the case when the tensile strength of the concrete is taken into account, and when it is neglected; the more important of the empirical formulæ, such as those due to Thacher, Christophe, and Hatt, are then explained, and two very complete tables are given for the safe loads in reinforced slabs of various spans, based on Thacher's formula.

The design of reinforced columns is then discussed, and the author by a series of tables shows how closely the strengths of such columns, deduced from the formulæ he gives, agree with the actual crushing strengths obtained in a series of tests at the Massachusetts Institute of Technology. The application of this system of construction to retaining walls, dams, sewers, &c., is very fully explained, several neat graphical constructions being given; and in this chapter the author deals with the very important problem of the use of steel reinforcement to prevent the cracks liable to occur in large concrete structures, such as dams and retaining walls, due both to shrinkage in setting and to thermal stresses, and he is of opinion that high carbon steel is more economical for this purpose.

In the last chapter of this section the testing and

design of reinforced concrete arches are taken up; after a brief explanation of the elastic theory and its application to the determination of the stresses in any arch, Thacher's formulæ for reinforced concrete arches are given, and their use in practice explained by the help of three typical examples of such arches, a highway bridge of two spans, each of 42½ feet, a single-line railway bridge of 72-feet span, and, lastly, a small semicircular arch culvert of 15 feet span. These three examples are completely worked out, the necessary graphical constructions being shown in full in three plates; this chapter will undoubtedly be found very useful to any engineer who is engaged in the design of such arches.

Parts ii. and iii. are the work of Mr. Hill, and deal respectively with representative structures and methods of construction; the following branches of work are dealt with:—foundations of various types, including reinforced concrete piles, floors, walls and arches in buildings, and columns. The illustrations selected, though largely American, include also a number of cases of work carried out in Europe on the Hennebique system. The application of reinforced concrete to large bridges and culverts is illustrated by a number of structures which have recently been put up in France on the Monier system, and it may be pointed out that some hundreds of bridges of this type have now been erected, principally in Germany and Austria.

The last section of the book, on methods of construction, is naturally largely taken up with the description of the various forms necessary in elaborate reinforced concrete work. The future security of the work depends entirely upon the care with which the forms are designed and erected, and the economy of the work is largely dependent upon forms so designed that they can be rapidly put into position, readily taken down, and readily re-erected on a fresh section of the work. Many valuable hints and labour-saving suggestions will be found in this portion of the book. The author has evidently based this section upon experience of a very varied character in the erection of reinforced concrete structures.

(5) This is another of the somewhat numerous text-books which have appeared within the last few months dealing with the important subject of reinforced concrete. The author points out that the use of steel merely embedded in stone or concrete, as in the well known skeleton system of construction, does not develop the best properties of each of these materials—reinforced concrete alone enables full advantage to be taken of the special qualities of both the steel and the concrete.

The first portion of the book deals with the physical properties of the two materials, concrete and steel, and a number of carefully selected tables is given of tests of these materials. The general theory of concrete-steel beams is then considered, and special emphasis is laid upon the necessity of an accurate knowledge of the moduli of elasticity.

We are afraid, however, that the author has fallen into confusion of thought in discussing the question of the position of the neutral axis; on p. 43 he refers to an imaginary beam of concrete and steel, and appears to consider that each square inch of the concrete will carry the same total stress, ignoring altogether the variation in intensity of stress with distance from the neutral axis; and again, in chapter iv., when discussing the position of the neutral axis, he states that the position of this is affected by the fact that the compressive strength of the material (concrete) is greater than its tensile strength. Surely there is confusion here between strength and modulus of elasticity, and this confusion seems to run through all the rules and calculations for the position of the neutral axis. This portion of the book certainly requires to be carefully revised if it is to become a trustworthy text-book on the subject.

The subject of floor design in concrete and steel is taken up, several large floors constructed on the Hennebique system are fully described, and tables are given of working stresses which can be allowed, and the building rules which have been laid down by various authorities in connection with the design of such floors. The application of reinforced concrete to foundation work in bad soils is discussed, and the author shows that by the use of this type of construction the depth to which the foundation must be taken can be very considerably reduced. The last chapter discusses the construction of reinforced concrete columns, special attention being given to Considère's hooping method.

CHEMISTRY FOR SCHOOLS.

Notes on Volumetric Analysis. By J. B. Russell and A. H. Bell. Pp. viii+94. (London: John Murray.) Price 2*s*.

Introduction to Chemical Analysis. By Hugh C. H. Candy. Pp. xii+114. (London: J. and A. Churchill, 1905.) Price 3*s*. 6*d*. net.

An Elementary Text-book of Inorganic Chemistry. By R. L. Whiteley. Pp. viii+245. (London: Methuen and Co.) Price 2*s*. 6*d*.

Elementary Chemistry, Progressive Lessons in. By F. R. L. Wilson and G. W. Hedley. Pp. xii+168. (Oxford: The Clarendon Press, 1905.) Price 3*s*.

A Three Years' Course of Practical Chemistry. By George H. Martin and Ellis Jones. Pp. viii+112. (London: Rivingtons, 1906.) Price 2*s*.

IT seems to have become a recognised practice for schools and colleges to produce their own small text-books or notes on some portion of the science curriculum, first for internal use, and then for the benefit of outsiders. Whether this multiplication of little books is desirable is somewhat questionable. Without going so far as to say that these small books conduce to cramming or getting through examinations, there is always a slight lurking suspicion about this point. Our various "examination" boards are perhaps answerable for the small book production.

Mr. Russell's book is intended, no doubt, for use on the working bench. The directions for working are short, mainly to the point and in logical order, but surely they are too frequently repeated.

After about twelve pages of instructions and examples on the use of permanganate, the student is still told to weigh out so much ferrous salt, make up to so much, &c.; little room is left for the student to think and find out for himself.

After the idea of "normal solution" has been once grasped, many of the directions might be left out. One somewhat objectionable point noted is the direction to weigh out a certain definite quantity of a substance, say 5·3 grams. This is not an easy matter for beginners. It is better to take a weighed quantity and make up solution to the desired strength by addition of the calculated proportion of water.

The ground covered ranges from acid and alkali through permanganate to silver and thiosulphate, preceded by a good description of the use of the burette, &c. The book will no doubt be useful, especially with large classes where the instructor is not able to get rapidly around to the students.

The preface of Mr. Candy's book informs us that the methods and processes of analysis and synthesis have been chosen to meet the requirements of students preparing for parts i. and ii. of the preliminary scientific examination in the University of London and the first examination of the joint board. After a sensible introduction, chapters follow on the identification of bases and acids, methods of separation and tests of purity, and a very useful chapter on preparations. In the latter section are included examples of preparations of mineral salts, acids, esters, alcohol derivatives, &c. The processes of taking a melting point and a boiling point might have been illustrated by a sketch. The preparation method for aldehyde is somewhat dangerous in inexperienced hands. It is safer to drop alcohol, very slowly, into the warm bichromate mixture and distil off the aldehyde as fast as formed. Some short chapters on equivalent and volumetric operations complete the book. The matter is clearly expressed, and the book will be useful for the class of students for whom it is intended.

The first forty-two pages of Mr. Whiteley's book deal with physical changes and physical properties. The book is rather freely illustrated by diagrams of apparatus, and the descriptions and explanations are generally quite clear, full, and understandable. It is designed for the use of those studying elementary chemistry on the lines of the Board of Education syllabus. The purely chemical sections include air, water, common salt, chemical theories, compounds of nitrogen, carbon and sulphur. There are appendices on solubilities of salts, questions and answers to calculations. The book should be very useful, especially to students unable to attend courses of experimental teaching or lectures.

The volume by Messrs. Wilson and Hedley is intended as a school course for beginners. It is entitled "Elementary Chemistry," but a large part of the book is concerned with necessary matters of elementary physics, such as measuring, length, areas, volume, the thermometer, density, solution, evaporation and boiling, Boyle's law, &c. The book is simply and clearly written, and illustrated by useful diagrams. Strictly speaking, there is no chemistry in the book, but we think all boys intending to commence that subject would benefit exceedingly by working through the excellent course here given.

The plan of instruction set forth by Messrs. Martin and Jones is to perform some experiments on a given substance such as mixing "salammoniac with quicklime and heating in a test tube." The inquiring student is then required to write out an account of what he notices, and to compare the results with those obtained when one of the substances is heated alone. Commenced with moderately young students who have not the bogey of an examination paper, or a particular syllabus, throwing a baleful shadow over them, this plan should produce excellent results. The book could scarcely be used to full advantage by students working alone, but with a sympathetic teacher at hand to fill in necessary explanations we think the volume a valuable addition to the host of books already available. W. R. H.

CERTAIN MODERN VIEWS ON PATHOLOGY.

Introduction à la Pathologie générale. By M. Félix le Dantec. Pp. x+504. (Paris: Félix Alcan, 1906.) Price 15 francs.

IN this work the author has grouped together a large and heterogeneous mass of information and speculation, always interesting and always fascinating. The first line of his introductory remarks leads us from the tubercle bacillus to the Milky Way, from the infinitely small to the immeasurably large, and we are soon assured that everything that exists in this formidable interval of space can be subject to investigation, provided it, in any way, can influence us. This promise holds good for everything, from an earthquake on the satellite of Sirius to an analogous occurrence in the interior of an electron; and so on, until after forty pages of pleasant reading we learn that the object of the book is principally to support the views of M. Bordet "and some others" as to the question of immunity. The theories of Ehrlich and his followers give a purely chemical interpretation of the facts of immunity, and are unsatisfactory inasmuch as they confound colloidal changes with chemical changes, properly so called. Ehrlich's views, he says, threaten to become to general pathology what Weismann's have been to biology.

"It is always dangerous to give names to things which do not exist—this is to create entities, of which it will afterwards be found extremely difficult to disembarrass oneself."

The author divides his book into two great sections. In the first he desires to advance slowly, to return frequently to the same subjects, so as not to come into too violent collision with the habit of thought of those who have for a long time been familiarised with the language of chemistry; also to give a short account of such of the properties of colloids as may be of interest to the biologist, and to sketch the main lines of the physical theory of serotherapy. Thus he leads the reader to the "notion" of the three heredities, chemical, physical, and symbiotic heredity. The

first part concludes with certain considerations as to the influence of radiations on the equilibrium of living substances.

In the second division of the work the author proceeds to render more precise the language prepared in the first part of his study. He reviews the more important types of infection, and particularly considers intracellular parasitism and symbiosis; then he passes on to the phagocytic studies of M. Metchnikoff, and uses a language different from the vitalistic expressions of the great Russian *savant*. Next comes the considerations of the comportment of the living organism towards injections of dead colloids, thus leading up to the study of infection proper, *i.e.* disease due to living micro-organisms. The above abstracts will suffice to show the aim of the author's book, and chiefly he desires to use "*the language of equilibrium*," language borrowed from physical chemistry. He holds the law of Le Châtelier valid for the modification which an organism undergoes when it triumphs over infection. "The modification produced in a system of bodies in a state of equilibrium by a variation of one of the factors in the equilibrium is of such a nature that it tends to oppose itself to the variation that determines it." His position is even more clearly defined on p. 184, where he says that he wishes to show that if the immunities that result from the resistance of organisms to infection resemble the phenomena of physical chemistry, the resemblance is exclusively on the physical side. He finds that questions on immunity and serotherapy are discussed in the language of chemistry, even by those investigators who do not accept the theories of Ehrlich—therefore the very words used are filled with unjustifiable hypotheses, and give an inflexible interpretation to phenomena. For example, the partisans of the chemical theory of serums admit the existence of two definite and complementary substances, "cytase" and "fixative," the former thermolabile, the latter thermostable, and these thermic relations, according to M. le Dantec, suggest that these substances—even if chemically definite bodies—act in virtue of their *physical* character rather than in accordance with their *chemical* structure.

The phenomena of bacteriolysis receive at the hands of Ehrlich a purely chemical interpretation; M. le Dantec deliberately states that the chief fault in Ehrlich's theory is that the serum-producing animal must have an immediate and profound knowledge of chemistry. This can scarcely be seriously meant.

Nowhere does he give a complete account of the views on immunity and toxins held by Ehrlich, nor is this to be looked upon as a fault, inasmuch as those of Ehrlich's opinions that he does consider he regards as entirely untenable. Still, this omission (if such it be) shows that the book will be of little use to a student really needing an introduction to general pathology, however interesting and instructive the work may be to the thoroughly equipped investigator; and to the latter the learned author doubtless addresses himself. First and foremost he is a biologist, and, moreover, is imbued with the belief that pathology is capable of throwing a flood of light on biological questions.

Many pages of the work remind us of the author's well known papers in the Annals of the Pasteur Institute, and these pages will be read by many with reminiscent pleasure.

Nowhere is the author more interesting and lucid than in his discussion of Mendelian or discontinuous heredity; his quotations are apt and instructive; his own remarks carry with them the imprint of careful study and original thought. In this connection he replaces the "*representative particles*" of Darwin and Weismann by the Pasteurian word "*microbe*"—meaning thereby *particles productive of diatheses*—and claims that by so doing he loses nothing in the narration of the facts, while gaining the advantage of placing the diatheses (characters of Mendelian heredity) apart from the characters of heredity properly so-called.

The book is well worth careful reading, and the author is to be congratulated on a work which will challenge the attention of the more advanced students of pathology. WM. ST. C. SYMMERS.

OUR BOOK SHELF.

Die optischen Instrumente. By Dr. Moritz von Rohr. Pp. v+130. (Leipzig: B. G. Teubner, 1906.)

THE aim of this little book, one of a series dealing popularly with various subjects of scientific or general interest, is to give a simple account of the development and modern theory of optical instruments, and to make clear to readers possessing no special technical knowledge the main features of their optical construction. The treatment is largely based on the work of Abbe; and in the introductory chapters, which deal with the general principles governing the formation of optical images and the consequences dependent on the characteristics of the eye, special attention is given to the question of aperture and the limits of the image-forming pencils, and to the manner in which the perspective of a picture may be modified in the image. In the application of these considerations to the photographic lens, the microscope, and the telescope, there is some novelty and interest. In other respects a clear and concise account is given of the main properties and aberrations of the different instruments, whether for objective or subjective use, with some brief historical notes. The section on the photographic lens is followed by useful particulars as to enlarging and projection apparatus; the description of the microscope includes a short explanation of Abbe's theory of microscopic vision, of the relation of "numerical aperture" to resolving power, and of the sine law, and even admits of reference to the possibilities of photomicrography with ultra-violet light. To the description of the ordinary forms of telescope are added some notes on the prism binocular as constructed by the Zeiss firm. The diagrams and illustrations are noticeably well drawn and clearly printed.

Second Year Chemistry, a Handbook for Laboratory and Class Work. By Prof. Edward Hart. Pp. vi+165. (Easton, Pa.: The Chemical Publishing Co., 1905.) Price 1.25 dollars.

THE plan of this book is to begin, after a few theoretical generalities, with some careful quantitative determinations. Thereupon follow qualitative analysis, chemical arithmetic, and, finally, more quanti-

tative analysis. The treatment is marked throughout by a considerable degree of originality, and the book appears agreeably free from the domination of an examination syllabus or of the authority of any particular school. It is unusual to find the determination of silicon in pig-iron or steel in an elementary book, and so also the use of a Hempel gas apparatus; but there is, after all, no good reason why the practical work of elementary students should not be interspersed with exercises of this more technical kind. It is astonishing what sanctity is still attached to the established order of practical chemistry, and it is not the least interesting feature of this book that it is markedly unorthodox. Most teachers will admit that they may profit by carefully inspecting the plans of instruction adopted by their well accredited colleagues, and such a remark may certainly be made of Prof. Hart's little book. A. S.

La Nature et la Vie. By Henry de Varigny. Pp. ii+356. (Paris: Armand Colin, 1905.) Price 3.50 francs.

IN a pleasant and easy fashion the writer of this book carries the reader from the beginnings of life to its termination by death. The origin of life on this planet, the vital phenomena of the lower and higher forms of vegetable and animal life, the part played by bacteria in the fertilisation of the soil, the evolution of living forms, parasitism, the multiplication of animals and plants, the beginning of the end, the problem of death, and the immortality of the protozoa are a few of the subjects dealt with. The book may be recommended as a good popular introduction for the educated but non-scientific reader to general biological problems.

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.*]

A Plea for Absolute Motion.

NEWTON believed in the possibility of absolute motion (*i.e.* motion in space not necessarily relative to other material bodies), founding his argument on the fact that the rotation of a planet might be detected by experiment on the planet itself without reference to outside bodies. Newton's reasoning is unanswerable, but it only takes us part of the way. Though it proves that using the principle of gyrostatic action we can determine direction in space absolutely, it fails to distinguish one parallel line from another. We can only observe relative motion. This statement, which no one doubts, is generally taken to be synonymous with the assertion that nothing but relative motion will ever be known. So firmly is this generalisation rooted in the present generation of philosophers that I am afraid the expression of a contrary opinion will only result in placing its author on the "Index" of De Morgan's Budget of Paradoxes.

It is therefore with considerable hesitation that I venture to raise the question whether we are not most of us in our innermost hearts believers in absolute motion, and whether a good deal of the persistence with which we try in our lectures to prove that no meaning can be assigned to absolute motion does not arise out of the desire to repress our own rebellious doubts. As regards the direct evidence of observation we are all agreed, but if from the outset we limit the results of reasoning to that which may directly be controlled by experiment, we must throw overboard a good many theories which are firmly believed in by men of science. I will try to show that it is almost impossible to exclude the idea of absolute motion from our discussions, and that some of our scientific definitions tacitly admit it.

The observed motion of the solar system through the stellar universe has frequently been introduced into the discussion of relative motion, but I do not think that its full importance has been recognised. The thesis I wish to maintain is that the question whether our solar system possesses velocity not only relatively to the stellar universe, but absolutely in space, constitutes a definite problem to which a scientific meaning can be attached. It is immaterial to my purpose whether our present observations are sufficient to allow us to draw any definite conclusions. If the validity of the question itself is admitted, my point is gained.

In order to free the main issue from the uncertainties arising out of the imperfections of our observations, I will base my argument on an ideal condition of the universe which resembles the real universe sufficiently to be admitted as a possibility. The displacement of a star relative to the solar system may be determined in two ways. While telescopic observations give us the angular motion in a plane at right angles to the line of sight, spectroscopic observations allow us to determine radial velocities. To determine velocities by means of the telescope we require to know the distance of the stars, but the determination of parallax is a question of instrumental perfection and of long-continued observation. We commit, therefore, no error in principle if we imagine the parallaxes of the stars in our ideal universe to be known, so that the combination of telescopic and spectroscopic observations can determine the relative velocity in magnitude and direction.

It is a matter of history that telescopic observations alone have led to the conclusion that the solar system moves relatively to the stellar system towards a point which, as fixed by Prof. Newcomb's discussion, has a right ascension of 277°·5 and a declination of 35°. Taking this point as apex, Prof. Campbell divided the heavens into eighteen zones, obtained by drawing circles of latitude at a distance of 10° with the apex as pole. In every one of the zones which had a smaller apical distance than 90°, the average motion was one of approach to the sun, and in every one of the zones having an apical distance greater than 90° the motion was one of recession from the sun. A complete discussion gave for the line of direction, as obtained by the spectroscopic method, R.A. 277°·5, dec. 20°, the right ascension agreeing exactly with the value deduced by Newcomb, though the declination differs materially. The relative velocity found was about 20 kilometres per second.

We may now idealise this observed universe so as to simplify the argument, and bring out its essential points. Divide the heavens into a number of compartments. Let in each compartment the relative velocities be measured for a large number of stars combining the spectroscopic and telescopic method. Let u be the average velocity of each group relatively to the solar system, so that the velocity of each star in the group can be represented by $u+v$, both quantities being vectors. For the sake of argument, assume that u is the same for all groups, and that v within each group is distributed according to the law of errors. As regards v, there is no predominance of any direction (otherwise u would be affected), and its magnitude will be distributed about its mean value in a manner which we will take to be the same for all groups. The question arises: How should we interpret such observations if the facts were as stated?

It is not sufficient to say that the observations would prove a relative motion $-u$ of the sun with respect to the stellar system, for this would only represent a small part of the facts. The important point brought out by the observations is that the relative motion is observed to be the same for the mean point in each one of a great number of groups of stars. The fact that within each group the distribution follows the law of errors leads to the conclusion that the groups are independent systems, and I put the question thus: Does it require an explanation why all these independent systems should have the same vector u imposed upon them? If you admit the validity of this question, if you begin even to discuss the alternative explanation that the vector u reversed really belongs to the solar system, and indicates its velocity, you have practically surrendered to absolute motion. If there were only one star in existence showing relative motion towards the

solar system, and someone were to begin to ask: Is it the star that moves or ourselves? we should at once reject the question as absurd, and say that the two alternatives mean the same thing. But I doubt whether there will be many who would be satisfied to contemplate a stellar universe, each member of which has the same relative velocity with respect to the sun, without feeling that here is a problem which requires investigation.

The ideal case considered might be realised if we could imagine observations to be taken from a molecule in a mass of gas enclosed in a box, the observations being taken in the interval between two collisions. If other molecules could be brought within the range of observation, we should, indeed, find that for the mean point in each group containing a large number of molecules the observed relative motion has the same value, that value being the reversed velocity of the molecule itself. If there were any ordinary common-sense philosopher placed on the molecule, he would argue that his observations have really determined the absolute velocity of his place of abode in space, but his wiser colleagues will tell him that he is wrong, and that he has only determined his velocity relative to the rest of the system. The common-sense philosopher would then justly claim that he has done more than that, and point out that the whole system of molecules can be divided into a great many groups, and that the relative velocity in all the groups is identical in magnitude and direction. With our greater knowledge from outside, we know that the velocity which has been determined really belongs to the molecule, and we should probably add (though this is not a matter which the supposed observations could have proved) that it is the velocity relative to the vessel which contains the gas. But even then not all the facts which the observer on the molecule has discovered are accounted for. If the gas could be set into violent motion, without altering the velocity of the particular molecule from which the observations are made, the observer would still obtain the same value for his relative motion, but the different groups into which he has divided his space would no longer give identical values. The complete conclusion to be drawn from the original observations is, that a velocity has been determined relative to an outside body which is mechanically connected with the system, and that each group of molecules is separately at rest relatively to this outside body.

Consider now the application of this example to our problem. If we could argue by analogy we should conclude that the observed velocity of the solar system really belongs to it, and not to the stars, but that it must be taken as relative to something which is outside the stellar universe, though connected with it. If that something is material, we should be forced to the conclusion that we have determined a velocity relative to a material body which has not come into our range of observations at all. The conclusion seems too absurd to be entertained. The only alternative is to replace what in the case of the gas was the containing vessel by something immaterial, which therefore we cannot imagine to be in motion. Not being capable of motion it must be at absolute rest, and we may identify it with that abstraction to which we give the name of space. All motion relative to space is absolute motion.

It may be said that if this argument is to be applied to the actual universe, I have left out of account a large number of bodies of which we have no cognisance because they are not luminous. It is possible that these obscure bodies would, if we could observe them, show a systematic motion which would quite upset the previous conclusions. To this I reply that I have treated an ideal case which may or may not coincide with the actual one. I have expressed no opinion as to whether, on the strength of present observations, we are justified in assigning absolute velocity to the solar system; but it may be pointed out that almost every theory which we now believe to be true may some day be upset by facts at present undiscovered, which cannot be reconciled with it. Should we come to the conclusion that our solar system is in motion we may have to modify that belief in the future, but this possibility does not prevent our being justified in adopting views which are in accordance with the facts at present known.

There is an easy way out of the difficulty. When we are driven to our wits' end we have recourse to the æther. Why, then, assume absolute motion when it is so simple to say that you have determined the motion relative to the æther? We should by this device be able to calm our consciences as regards relative motion, no doubt, but at the expense of logical consistency. A moment's reflection will show that the æther has nothing to do with the question. If the æther were non-existent and the corpuscular theory of light were true, the displacement at right angles to the line of sight would still be observed, and as regards the radial velocities the contemplation of the corresponding acoustical problem is decisive. The note of the whistle of an approaching engine is quite independent of the direction of the wind. Similarly, the observed Doppler effect when the spectra of stars are examined is independent of any uniform drift there might be in the æther. No doubt we may, and probably must, consider the æther as immovable in space, and in that case absolute motion in space becomes identical with motion relative to the æther; but the direct conclusion derived from the observation of stars applies to space, and not to the æther.

All our observations of position can only be relative to some standard point. Motion involves change of position, hence motion can be relative only. This is the main argument on which the impossibility of absolute motion is founded. But it proves only that *observed* velocity must be relative, and not that there is nothing real corresponding to absolute velocity. The argument also assumes the very doubtful proposition that velocity must be derived from change of position. It may be the other way round, velocity may be the more fundamental thing, and change of position may have to be derived from it. It seems to be equally logical to take $s=\int vdt$ or $v=ds/dt$ as the equation representing the relationship between the position and velocity. Indeed, if we read Poincaré's description of how we form our ideas of space, we must be struck by the importance attached to the muscular sensation which accompanies a change of position of our bodies. To quote only one of his sentences:—"None of our sensations could have led us by themselves to the conception of space. We are led to this conception only by studying the laws according to which our sensations succeed each other." Bearing this in mind, it seems rational to start from the idea of velocity as rate of change of position, and deduce the idea of position from it. Rest would become an abstraction, and would have to be defined as an infinitely small motion.

There is, however, another way of looking at it. It is known that it is much more difficult to convince ourselves of the objective nature of time than of space or velocity. In fact, I believe most metaphysicians now would deny the objective nature of time altogether. It might therefore be useful to accept both position and velocity as fundamental conceptions, and deduce time intervals from them. In any case, sufficient has been said to show that the practical definition of relative motion cannot in itself be taken to prove that absolute motion is an impossible conception.

If I suggested at the outset of this discussion that most of us have all along been secret believers in absolute motion, I was led to that belief partly by the manner in which the problem of solar motion in space has always been treated. Those who have drawn the logical conclusion from the observations have not infrequently guarded themselves by some statement that after all it is only relative motion they are trying to prove. But their discussion nearly always tacitly assumes, not relative, but absolute motion, and I think most astronomers and physicists, if taken unawares, would admit the absolute motion of the solar system in space as a proved fact, though on second thoughts they might try to explain it away by motion relative to the æther or by some other expedient invented *ad hoc* to safeguard their true faith in relative motion.

But a tacit assumption of absolute motion is also included in the definition of force which at present is much in favour. "Force is rate of change of momentum." If velocity is relative, momentum is relative also. The above definition is therefore incomplete, and may be misleading unless it is definitely stated what the standard system is relative to which momentum has to be measured. Even

quite apart from the earth's rotation the force of gravity impelling a body to the ground is not correctly measured by the rate of change of momentum relative to the earth. Though the neglect of the mass of the body itself, compared with that of the earth, may not lead to serious contradictions in this particular instance, the definition is wrong in principle unless absolute momentum be meant, or unless it be specified that the momentum has to be taken relative to some body unacted on by any forces.

For our definition of force we shall have to return to Newton, and I may have to trouble you with a further communication to justify my belief that though modern criticism has been able to point out the weak spots of the Newtonian system, it has failed to substitute any more secure or more logical basis for our foundation of mechanics.

ARTHUR SCHUSTER.

The Diffusion of Solids.

IN view of the interest attaching to the vaporisation and diffusion of solids, the following observations may be worthy of record.

On the inside of the case of a silver watch between forty and fifty years old, and opposite the steel pin of the key-hole, a diffused, dark patch, larger than the key-hole itself, was noticed. When a drop of strong hydrochloric acid was placed on the spot, bubbles of gas were evolved, and the colour gradually became lighter, though after ten minutes, when action had apparently ceased, the patch was still plainly marked. On adding a drop of potassium ferrocyanide solution the blue precipitate due to iron was formed. Similar results have been obtained with other old watches. Since it was shown that the iron was not in contact with the silver, the facts indicate that the iron, or possibly some compounds of iron contained in it, vaporises, dissolves in the silver, and penetrates for some distance into the latter by diffusion.

Prof. F. D. Brown has observed an effect of similar nature. On a porcelain writing tablet were notes written in blacklead perhaps forty years ago. While recent writing is easily removed, these marks can no longer be defaced in any way by washing or mere surface scratching, showing that the carbon has penetrated into the porcelain no inconsiderable distance. That this should have taken place in the case of two such refractory solids as carbon and porcelain is all the more remarkable.

JOHN H. HOWELL.

Grammar School, Auckland, N.Z., February 4.

Earth Tremors in India.

IN connection with the short description of the Kangra earthquake, and the reference to the still greater earthquake of 1897, contained in NATURE of March 1, p. 418, it may be of interest to note that, at a distance of about twelve miles from the point that was supposed to be the centre of greatest disturbance in the latter earthquake, tremors were still appreciable, at frequent intervals, in the early part of 1904.

While we were sitting on the verandah of the Government bungalow at Rongmudu, in the Garo Hills, near the point at which the river Somersary changes the direction of its flow from east to south, in the early afternoon of February 10, 1904, my travelling companion, Mr. A. B. Nowell, of Dwarra, Sylhêt, directed my attention to a booming sound like the beating of distant gongs, and at the same time pointed to a glass of water standing on the table in front of us, in which the water was distinctly agitated. The tremor lasted for only ten or fifteen seconds.

Mr. Nowell, who had spent some months of each year in that neighbourhood for several years in succession, informed me that tremors occurred at frequent intervals every day when he first came there, but were getting fainter and less frequent as time went on. Later in the same day he directed my attention to another tremor, but as we were then walking in the jungle I failed to appreciate it. On the following day we travelled many miles southwards, or away from the centre of disturbance, so that I had no further opportunity of observing these phenomena.

W. GALLOWAY.

Peculiar Ice Formation.

I SHOULD like to direct attention to a peculiar ice formation which I have noticed during the last week on the moorland area at this place, and I should be glad to know if this phenomenon has been observed elsewhere.

The moorland here is of considerable extent, and at a height of 1000 feet above the sea level. The rocks on the upper surface are of a brittle shale with outcropping sandstone, and on the lower slopes beds of clay and gravel. On March 2 I noticed the surface of the ground for distances of a hundred yards or more raised to a height of from 1 to 2 inches, and supported by ice pillars, which had evidently grown by addition of water from below the surface. The sensation of walking on these patches was somewhat analogous to that observed when walking upon a good pile carpet. The late snows had all melted, but the surface contained much moisture, and there had been a certain amount of frost the previous night. The time was 9.30 a.m., and as I stood there these ice pillars crackled and fell in such order as to give the surface a honeycombed appearance.

I found on examination all the talus slopes in the gullies of the moorland to be covered with the same ice structure. These ice pillars were not very evident until some of the earth had been cleared away, as a thin layer of earth was held up in a very uniform manner on the top of them. I found them perpendicular to the surface, both on the pathway and upon the inclined surfaces in the gullies. Several hours afterwards, when the heat of the sun's rays had melted the ice pillars, the whole surface presented a honeycombed appearance. I only noticed this to have taken place in those areas void of any vegetation whatever, and where the heat would be quickly radiated into the atmosphere. The whole of these areas is now broken up into a very fine titrated soil; if this tendency to superficial vertical ice thrust is at all general, it appears to me to be a great factor in the disintegration of surface soils.

JAMES FOULDS.

Darwen, Lancashire, March 5.

Cooperation between Scientific Libraries.

IN connection with the discussion raised by the note on Dr. Muir's paper (p. 372) and Dr. Bather's letter, it may be of interest to note that the Royal Irish Academy, some five years ago, prepared a classified card-catalogue of the scientific serials accessible in various libraries in Dublin, and it is proposed to keep this up to date through the cooperation of the various librarians. This catalogue is always ready for reference by any member or visitor in the academy's reading-room; and it has been of late years the custom for the library committees of various Dublin institutions to inquire, when a new periodical is proposed, as to its possible previous inclusion in one of the other libraries.

GRENVILLE A. J. COLE.

March 10.

Sounding Stones.

WITH regard to Mr. Tingle's letter in NATURE of January 4 (p. 222) on sounding stones, it may interest you to know that I have just seen at Pagan, the former capital of Burma, now in ruins, a large log of fossil (or rather silicified) wood, used as a gong. It emits a clear ringing note when struck, and is used, like all pagoda bells or gongs, to direct the attention of the guardian spirits to the offering about to be presented by the pious Buddhist.

O. F. WHEELER CUFFE.

Meiktila Upper Burma, February 11.

An Inquiry for Books.

CAN any reader of NATURE direct me to English books on the history of Arabic literature, history of Arabic education, and general sanitation?

G. HAMMÂM.

Oriental College, Zahleh, Beirût, Syria, February 24.

A NEW COUNTY BIRD-BOOK.[1]

A BOOK on the birds of Hampshire and the Isle of Wight fills up a blank in the list of English county avifaunas, and is a particularly interesting instalment of the series. Few, if any, districts in Great Britain surpass this in the attractions it possesses for the field naturalist, its natural features presenting a greater variety than is usually to be found in an area of similar limitations, large though this county is. If it boasted of nothing more than the far-famed New Forest, the happy hunting-ground of so many naturalists, Hampshire would furnish material for a good bird-book. But in addition to its woodlands it embraces open downland and hills, cultivated country and a varied coast-line including the muddy estuaries and harbours of the mainland and the famous cliffs of the "Island." It is not, therefore, surprising to find the district credited with a list of 127 resident birds and summer visitors, which remain to breed, in addition to 70 winter visitors, 36 occasional visitors, and 61 species of so rare occurrence that the authors are obliged to attribute their appearance to accident. With regard to the occurrence of rare visitors on migration, the authors point out that the lighthouses and vessels (to which are due the discovery of so many waifs) on this coast are not good stations for observation.

Hampshire has not been less fortunate in her naturalists and her natural historians than in her natural features. From the days of Gilbert White onwards the birds of Hampshire have been studied and loved by many notable people. Hardly less known than the "Natural History of Selborne," we have the immortal "Instructions to Young Sportsmen" of Colonel Peter Hawker, and his more recently published "Diary"; Gilpin's "Forest Scenery" and Wise's "History of the New Forest." These, added to the writings on local birds of the Rev. C. Bury, Captain Henry Hadfield, Prof. T. Bell, Mr. A. G. More, the Rev. Richard Warner, Mr. G. B. Corbin, Mr. E. G. B. Meade-Waldo, and others, have furnished the authors with a wealth of material stretching back to a time when little attention was paid to ornithology. But besides these more pronounced naturalists, famous men of letters, and women, too, have made some mention of Hampshire birds—Kingsley and Tennyson, and Jane Austen and Charlotte Yonge—while the modern maker of books has not left them alone.

In collections, too, the county is rich, and that of Mr. E. Hart (without whose assistance no history of Hampshire birds could be complete) at once suggests itself as of preeminent importance. The strictly local collection at Heron Court contains many historical specimens, while the eggs owned by Dr. Rake are of exceptional interest, many of them being referred to in Wise's "History of the New Forest." The work has been excellently planned and carried out. With such a wealth of historical facts available the authors proposed not only to deal with the birds as they exist at this moment, but to trace their history in the writings of those who have gone before them. The "Natural History of Selborne" forms the backbone of the work, and we have here for the first time what White has to say (not only in his book, but also in his still unpublished "Journal of Observations") about the birds of Selborne arranged in scientific order.

Of the more interesting species the authors have given very extended notices, and of all these the honey buzzard is the most important, on account of its having been found in former years more commonly in this county than in any other part of England. Among other birds of which valuable accounts are given may be mentioned the raven, buzzard, hobby, Montagu's harrier, cirl bunting, hoopoe, and great bustard. The breed of peregrines for which the Isle of Wight was famous in the old days of hawking still keeps a footing there; and to turn from decreasing species, it is pleasant to read that the redshank is increasing as a resident; that White's "clamouring" favourite, the stone curlew, is happily still plentiful, and that the woodcock, shoveller, and tufted duck are becoming more numerous as breeding species. But whether the great increase in numbers of the black-headed gull will prove an unmixed blessing is perhaps open to doubt.

FIG. 1.—Black-headed Gull. From "The Birds of Hampshire and the Isle of Wight.' From a photograph by Mr. Smith Whiting.

A curious account is given of some merlins breeding in Hampshire in the early 'sixties. The nests, which were stated to have been found in such previously unheard-of situations as pollard hollies, and holes in yew and beech trees, contained three eggs in each instance. We should certainly have been inclined to refer these eggs to the kestrel had not the male bird been shot from the nest in one instance, and had not its skin, together with the eggs, been

[1] "The Birds of Hampshire and the Isle of Wight." By the Rev. J. E. Kelsall, M.A., and Philip W. Munn. Pp. xliv+371; illustrated. (London: Witherby and Co., 1905.) Price 15s. net.

still in existence. An interesting introduction closes with an account of the laws applying to local birds; and the volume is embellished with a map of the district, four drawings by Mr. G. E. Lodge, and reproductions of some most beautiful photographs of birds by Mr. Smith Whiting, one of which we are enabled to reproduce. O. V. APLIN.

THE ADULTERATION OF BUTTER.

DURING the last few years much unscrupulous ingenuity has been applied to the sophistication of butter. Both on the Continent and in this country the adulteration of this, the best of edible fats, has developed into quite an industry, having its own factories and its own chemists, and conducting its operations on a scale which, for a furtive, dishonest business, is really of remarkable magnitude. Considerable profits are alleged to be made, and it is therefore not surprising that the traffic has flourished in spite of all attempts at suppression. Perhaps it may be of interest to those readers of NATURE who are not chemists to have placed before them, with as little technicality as may be, a sketch of the modern methods of butter-adulteration, and of the means adopted or suggested to checkmate this form of fraud. The importance of the matter both to the consumer and the agriculturist may be pleaded as a justification for discussing the question at some little length.

Butter, though consisting essentially of the fat of milk, is always associated during manufacture with more or less water, the quantity of which ranges generally from 7 to 15 per cent. One of the simplest forms of adulteration consists in working an excessive proportion of water into the butter. To check this is comparatively easy; a maximum limit of 16 per cent. has been fixed by the Board of Agriculture, and persons dealing in butter containing more water than this are liable to prosecution.

There exists, however, an insidious variant of this water-logging in the production of what is called "milk-blended" butter. In preparing this, skim milk, costing about a penny per gallon, is largely used. It may either furnish curd to be incorporated with the butter, or, after a little "ripening" with micro-organisms to improve the flavour, it may be used for direct admixture. By working up butter with such milk a product may be obtained containing 25 to 30 per cent. of water, as well as a substantial quantity of curd. The proportion of butter-fat in such a mixture will often be less than 65 per cent., whereas ordinary butter contains from 80 to 90 per cent. Yet the sale of the article is not, legally, a fraudulent transaction, provided the substance is sold as "milk-blended" butter, and not simply as "butter." At first sight this may seem reasonable enough; the purchaser is told what he is buying, and for the rest—well, *caveat emptor*. But, after all, some regard should be had to attendant circumstances. It is the poor who chiefly consume the manipulated butter, and neither they, nor, indeed, any ordinary purchaser, would realise that the fat-value of the blended article is only about three-fourths of that of genuine butter. Of course, if the price is correspondingly lower there is no fraud. But the contention of those who oppose the sale is that there is always a substantial margin of unfair profit; "milk-blending," in fact, is held to be essentially a device for supplying an excessive proportion of water, relative to the amount of fat, without incurring the penalties provided for infringement of the Sale of Butter Regulations.

Be this as it may, a measure to prohibit the use of the word "butter" for such mixtures, on the ground that it is a misleading description, was brought forward two or three sessions ago, only to be sacrificed to the exigencies of politics. It remains to be seen whether a better fate is in store for it under the new Administration.

Perhaps, however, the most frequent, and certainly the most troublesome, sophistication of butter consists in the admixture with it of fat other than that of milk. There are two chief adulterants of this class now in use. One is a soft fat obtained from beef-suet by removal of the harder "stearin" portions; this fat may sometimes be mixed with or replaced by lard, and is generally churned up with water (or with milk) to facilitate the subsequent "blending." The other adulterant is a refined cocoa-nut "oil" or fat, purified so as to be practically tasteless. These substances, supplied at about half the price of butter, are variously known as "mixing article," "enricher cream," "neutral fat," or "neutral blending," and are carefully prepared to simulate butter in consistency. A still more subtle adulterant is formed by a judicious mixture of the two, which yields analytical figures identical in some respects with those of genuine butter. Let us examine this a little more closely.

Chemically, butter-fat consists of a mixture of glycerides—that is to say, compounds of fatty acids with glycerin. For instance, one such glyceride may, with sufficient accuracy for our present purpose, be represented as the following combination :—

Glycerin + Oleic acid, Palmitic acid, Butyric acid } *minus* water.

When these acids are freed from their chemical union with the glycerin, the butyric acid is found to be sharply distinguished from the other two by the fact that it is soluble in water and volatile on distillation with steam. Now the chief difference between butter-fat and other fats lies in the comparatively high proportion of butyric acid (and similar volatile acids) which the butter-fat contains. The following summary represents the composition of a specimen of the prepared beef-fat and of two samples of butter-fat :—

	Prepared beef-fat	Butter-fat	
		No. 1	No. 2
	Per cent.	Per cent.	Per cent.
Volatile or soluble acids	Practically nil ...	5·0 ...	6·7
Insoluble acids	95·5 ...	90·0 ...	88·0
Glycerin	10·9 ...	12·1 ...	12·7
	106·4	107·1	107·4
Less combined water	6·4	7·1	7·4
	100·0	100·0	100·0

Like other natural products, the fat of milk varies in the proportions of its components, and the two samples here quoted show the range of variation met with in ordinary butter. Analytically, No. 1 is butter of low quality; No. 2, on the other hand, is above the average. The difference consists, as will be seen, in No. 1 containing less volatile acids, less glycerin, and more insoluble acids than No. 2. These are precisely the directions in which beef-fat differs from butter-fat. Broadly, one may say that, analytically, the first specimen of butter has more of a beef-fat character than the second.

This is the point which the adulterator seizes upon. "If," he argues, "I start with butter No. 2, I can add to it quite a considerable quantity of my prepared beef-fat before the mixture shows a smaller percentage of volatile acids than butter No. 1 contains; and since No. 1 is perfectly genuine butter, it is difficult to see how any analyst will be able to swear that my mixture is not also genuine butter." Indeed, the analyst often finds it no easy matter to expose the

fraud. If butter had always the same composition the matter would be simple enough. It is the natural variation, small though it be, which has hitherto enabled the sophisticator to pocket his ill-gotten fortune.

This variation arises from a number of causes, of which some at least have been fairly well elucidated. In the main it is due to differences in the feeding and treatment of the cows. For instance, Dr. J. J. L. van Rijn showed some years ago in Holland that with the approach of winter, when grass was becoming poorer and less plentiful, and cows, kept late in pasture, were much exposed to cold, the proportion of volatile acids in the butter became abnormally low; but that as soon as the animals were stabled, and therefore better fed and protected from inclement weather, the volatile acids began to increase. To treat the cows more generously in the matters of warmth and provender was thus the remedy for the abnormality indicated. Nevertheless, there still remain some minor causes of variation, such, for instance, as the different physiological conditions of the cows in varying stages of lactation. The effects of these, however, are largely neutralised when we deal with butter made from the mixed milk of many cows; though they have to be taken into account where nothing is known about the history of a particular specimen of butter.

What, then, it may be asked, are the means by which any check at all can be placed upon the sophistication? Having regard to the variation in admittedly genuine samples, is not analysis useless except in very gross cases of fraud? By no means. Let us see what it can do, and how it may be supplemented.

In his search for adulterants the analyst may determine the following constants of the butter-fat he is examining:—(1) Its specific gravity: in butter this is higher than in beef-fat, but lower than in cocoa-nut oil; (2) its refractive index: this again is intermediate in value between those of the two adulterants mentioned; (3) its "saponification" value, which gives a measure of the total quantity of fatty acids and also of the glycerin; and (4) most important of all, the proportion of volatile acids. So far as concerns butter, these physical and chemical data are all correlated with the fact that glycerides of the volatile acids form a relatively large proportion of the genuine fat. They are therefore correlated with one another, and, within limits, are interdependent. The more volatile acid there is, the greater is the specific gravity and the higher the saponification value, whilst the refraction alters inversely. There is thus a kind of parallelism preserved among the constants of genuine butter, notwithstanding the variations in their absolute values. For instance, given genuine butter-fat such as that already referred to as "No. 2," with 6·7 per cent. of volatile acids, one can predict with confidence that its specific gravity will be pretty close to 0·9130 (37°·8 C.), and its saponification value not much different from 232. On the other hand, if the butter-fat contains, like No. 1, only 5 per cent. of volatile acids, we can say with equal confidence that its specific gravity will be about 0·9105, and its saponification value approximately 222.

Suppose, now, an adulterator mixes cocoa-nut oil with the first of these butters until he has reduced the volatile acids from 6·7 per cent. to 5 per cent., the quantity in the second butter. Such an admixture would easily be detected, notwithstanding the fact that the volatile acids correspond in quantity with those of genuine butter. For one thing, these acids can be further examined and made to yield evidence of the admixture; and for another, the addition of the cocoa-nut oil has destroyed the parallelism referred to; the figures are now quite inconsistent with one another, and the sophistication is readily demonstrable. Speaking generally, with a sufficiently extended analysis there is no particular difficulty in detecting relatively small quantities of cocoa-nut oil in butter. But a mere determination of the proportion of volatile acids will not suffice—which explains, perhaps, why this special form of fraud has enjoyed a rather longer life than it might otherwise have had.

The addition of beef-fat or lard is somewhat more difficult to prove. Reliance has chiefly, though not entirely, been placed upon the consequent diminution of the volatile acids. Unfortunately, the natural variation of these in genuine butter is rather considerable, as has been pointed out. Yet even so, it does not follow that the lowest known limit for volatile acids must be taken as the criterion in forming a judgment. There are often collateral circumstances which narrow the range of admissible variation. For instance, a large consignment of "creamery" butter must necessarily, under ordinary commercial conditions, be a product of the mixed milk of many cows, and hence the proportion of volatile acids must tend towards the average value. The minimum quantity, which in exceptional circumstances milk-fat from a single cow might admittedly show, is here lost in the general mean. No weight need be given to it in judging the genuineness of the butter. Similarly, samples purporting to be butter produced in the summer or winter months cannot claim to be judged by the low minimum sometimes found in autumn butter. Again, it may be known, from systematic analyses of genuine butter produced in a certain region, and sampled in circumstances which guarantee the representative character of the samples, that the butter of this region in a specified month did not, as a fact, fall below a particular value in the matter of volatile acids. By having regard to these and similar considerations, as well as to the actual analytical figures, it has been possible in many cases where butter adulterated with beef-fat or lard had been imported into this country from the Continent, not only to prove the fact of the adulteration, but to form a fairly close estimate of its amount.

Some check has thus been placed upon the fraud in question. Yet, although the means at disposal will serve to discover the more considerable amounts of adulteration, there is still a residuum of cases which are either doubtful or in which the legal proof is difficult by reason of the clever way in which advantage has been taken of the natural variation in the constants of butter. To deal with these cases other means are required in supplement of the chemist's work. In Denmark, for instance, there is official supervision of the butter industry; and in Holland the Government has organised an admirable system of State "control," whereby the official *imprimatur* is accorded to butter produced in factories under the Government inspection. Joining the "control," however, is at present a voluntary matter, and for factories not under it, and which may be suspected of malpractices, a compulsory and more rigid system of inspection has been proposed. In this country a considerable amount of falsification has been going on. Enterprising and unscrupulous individuals import or manufacture the adulterants mentioned above, and offer, in consideration of a substantial fee, to initiate the proprietors of butter-blending factories into the whole art and mystery of butter-"faking." As regards the suppression of this, the Customs authorities in the first instance endeavour to secure that all importations of adulterants coming within the legal definition of margarine shall be marked accordingly,

in order that their destination may be the better traced. Further, the traffic in the finished mixture has been somewhat checked by a number of prosecutions, undertaken by Government in the case of imported products, and by a few local authorities in cases where the "blended" butter was sold in this country. But to kill the snake instead of merely scotching it additional weapons are required. Useful measures for this purpose would be: (1) To adopt a recommendation made by a departmental committee some years ago, that a minimal limit for volatile acids should be fixed, below which a presumption should be raised that the butter is not genuine; this would strengthen the hands of the public analyst, and though it would not altogether stop the adulteration, it would restrict its amount and diminish the profits accruing therefrom. (2) To enact that no substance shall be sold as butter if it contains less than 80 per cent. of butter fat; this would prevent the "loading" of butter with curd or "solidified milk." (3) To organise a system of strict inspection of butter factories. (4) To give the Commissioners of Customs greater powers for regulating the admission into this country of adulterated butter and of substances which may be used in the adulteration of butter. (5) Most effective of all would be for the Government of each butter-exporting country to adopt some system modelled on the Netherlands "control" plan of combined inspection and analysis, and to furnish an official voucher of purity, without which the butter would either not be admitted here at all, or only under special conditions of marking. For this, however, we shall have to wait. C. SIMMONDS.

A REMARKABLE DISCOVERY IN EGYPT.

ON February 7 a most important discovery was made by Prof. Naville at Thebes. The excavation of the eleventh dynasty temple at Deir el-Bahari, discovered by Prof. Naville and Mr. H. R. Hall, of the British Museum, in 1903, has since been carried on for the Egypt Exploration Fund by these gentlemen, assisted by Mr. E. R. Ayrton. Mr. Ayrton being unable to continue working for the Fund this year, his place was taken by another of the Fund's excavators, Mr. C. T. Currelly, who joined the expedition for the first time this year. During this season work was first carried on by Messrs. Hall and Currelly in the southern court of the temple. Here were discovered some interesting priests' houses (?) of brick, dating from the time of the twelfth to eighteenth dynasties, and the south temenos-wall of the temple. This wall was found to be of the same type as the south wall of the great temple of Queen Hatshepsu, which was thus shown to be in reality the north temenos-wall of the eleventh dynasty temple. Later on Mr. Hall began the excavation of the back part of the temple to see how it ended. He discovered, Prof. Naville says, "the enclosure wall and found that the enclosure was interrupted by a court or wide avenue, lined on both sides by a single row of columns, and directed towards the mountain. The rock had been cut open to make way for the avenue."

Later on, when Prof. Naville reached Thebes and Mr. Hall left for England, work was directed to the exploration of the remains of an eighteenth dynasty building, also in the back part of the temple, which had been discovered by Messrs. Hall and Ayrton in 1904. At the end of this building was made Prof. Naville's splendid discovery, described by him in the *Times* recently. It consists of a cell or chapel excavated in the rock, lined with coloured relief sculptures depicting King Thothmes III. making offerings to the god Amen, and in the midst of it was found intact the original cult-image, a great painted and gilded stone cow, of life size. The cow was the emblem of Hathor, goddess of the western desert-hills, who was specially venerated at Deir el-Bahari. The image was dedicated by King Amenhetep II., the son and successor of Thothmes III. The chapel belongs really, not to the eleventh dynasty temple, although placed at the end of it, but to the great temple of Deir el-Bahari, with which it is contemporary. The great interest of the figure of the cow, besides its importance as a work of art, lies in the fact that this is the first time that an Egyptian cult-image has been found intact in its shrine. The whole chapel and image will be re-erected in the Museum of Cairo. Illustrations of the find were published in the *Graphic* and *Daily Graphic* of March 2.

This discovery is the latest proof of the remarkable nature of Prof. Naville's work for the Egypt Exploration Fund at Deir el-Bahari, which is one of the most interesting sites for archæological work in Egypt, and one of the most productive of interesting small antiquities, chiefly votive offerings to Hathor of the time of the eighteenth dynasty. These often are in the shape of little cows of blue glazed faïence, models of the great cult-images in the various cave-shrines of Hathor, of which the newly discovered chapel is one, the chief being the well known Hathor-shrine, with the red painted reliefs, on the platform of the great temple, found by Mariette many years ago.

The work of the Egypt Exploration Fund, which is now being carried on by Prof. Naville and his assistants alone, needs considerably more monetary support than is at present being extended to it. It is to be hoped that this discovery will act as an incentive to those who are really scientifically interested in the progress of archæological knowledge, no matter by what *person* that progress is effected, to give their help to the Egypt Exploration Fund, which discovered Naukratis and the store-city of Pithom, identified the route of the Exodus, excavated Tanis, Bubastis, and Herakleopolis, scientifically explored the tombs of the most ancient kings at Abydos, and is now bringing successfully to an end its most imposing work, the excavation of the two temples of Deir el-Bahari at Thebes.

NOTES.

THE Bakerian lecture of the Royal Society will be delivered by Prof. John Milne, F.R.S., on Thursday next, March 22, on "Recent Advances in Seismology."

PROF. O. HERTWIG, professor of comparative anatomy, University of Berlin, and Prof. H. O. Osborn, professor of zoology, Columbia University, New York, have been elected foreign members of the Linnean Society.

THE annual general meeting of the Chemical Society will be held on Friday, March 30, when the president will deliver his address, entitled "The Living Organism as a Chemical Agency: a Review of some of the Problems of Photosynthesis by Growing Plants."

AN unprecedented mining disaster occurred on March 10 at the Courrières colliery in the department of the Pas de Calais. An explosion of fire-damp resulted in the loss of more than 1100 lives. The causes of the explosion have not yet been fully established. The colliery employed 6998 persons, and possesses forty-four seams of coal; the annual output is about 2,000,000 tons. In 1890 attention was directed to this colliery by Sir C. Le Neve Foster on account of the remarkably low death-rate from falls of ground, and it was reported upon by a deputation of H.M. Inspectors of Mines. The average death-rate from

falls of ground per million tons of coal raised in the period 1890 to 1899 in Great Britain was 2·16, whilst at Courrières it was 0·39. The colliery was certainly admirably managed, and this fact makes it difficult to account for the terrible explosion, the immediate cause of which appears to have been an underground fire.

WEATHER of a very wintry type has been experienced this week over the British Islands, and in places the cold has been unusually severe for the time of year. On Sunday a large and important storm area arrived from the Atlantic, and in the course of the day its centre traversed Scotland. As the storm was approaching, strong westerly winds and gales, with heavy rains, were experienced generally. The storm developed considerable energy after reaching the North Sea, the barometer falling as low as 28·4 inches, and in the rear of the disturbance the wind greatly increased from the northward. Strong northerly gales accompanied by heavy squalls of snow or hail were experienced on Monday over nearly the entire country, and the storm occurring at the time of spring tides caused severe floods, especially along our east coast. The German and Dutch coasts have also suffered greatly. Sharp frost was experienced in Scotland and over the northern parts of England.

CANON TRISTRAM, F.R.S., whose death, at the age of eighty-three, took place on March 8, is believed to have been the first zoologist to make special application of the theory of natural selection. This he did in an article on the "Ornithology of Northern Africa," published in the then newly established journal the *Ibis* for October, 1859 (vol. i., pp. 429–433), and before the appearance of the "Origin of Species," grounding his belief solely on the papers communicated to the Linnean Society on July 1, 1858, by Messrs. Darwin and Wallace (Journ. Proc. Linn. Soc., iii., Zoology, pp. 45–62). "Writing," he said, "with a series of about 100 Larks of various species before me, I cannot help feeling convinced of the truth of the views set forth" in those communications. "It is hardly possible, I should think, to illustrate this theory better than by the Larks and Chats of North Africa." There is no room here to reproduce the next three pages, but they are worth reading now if only as recording an early and full acceptance of the Darwinian doctrine, and whether so much courage was shown by anyone elsewhere seems very doubtful.

MR. HALDANE, Secretary of State for War, in making the customary annual statement as to the policy of the Army in the current year, delivered a speech which has been received with much satisfaction in the scientific world. The need for clear thinking and for the application of the methods of science to the affairs of State was recognised frankly and emphasised repeatedly. Mr. Haldane's encouraging words to the military experts of to-day, his definition of the science of military organisation, and his description of a new school of young officers—as much men of science as engineers or chemists—should serve to inspire Army men with the spirit that must actuate successful practice. The Secretary for War assured the nation that our officers are becoming men with scientific training and reflective minds, and there is every hope they will soon work in connection with a thinking department such as that which took so prominent a part in securing the recent Japanese success. It is fortunate for this country that the Secretary for War believes in the application of scientific knowledge to military affairs, and we look forward to the time when this need for scientific thought will be recognised in every branch of the public service.

THE correspondence on the cause of the loss of the coal-tar colour industry, which is represented in Germany by a capital of 5,000,000*l*., with an annual value of about 50,000*l*., and the prospect of other industries passing out of our hands in the same way, continues in the columns of the *Times*. The writer whose article upon the jubilee of Dr. Perkin's discovery gave rise to the correspondence states in the issue of March 10 that in the early days of the coal-tar industry there were not a few accomplished chemists in England, but they could not find employment in the colour factories; and this being the case, the schools naturally felt discouraged in their efforts to produce men specially qualified for such work. "Our methods of policy," he remarks, "must be very different from those adopted in the past if we are to succeed; complete sympathy must be established between science and industry." The meaning and value of research have yet to be understood by the commercial community and the manufacturers of this country; and it is still necessary to impress upon the nation that scientific method is an essential factor of the development of industries. When there is a scientific laboratory in every works, the National Physical Laboratory will be able to take its proper place in a national scheme for the promotion of progress of applied science.

THE death of Mr. J. G. Goodchild removes a geologist and naturalist whose knowledge covered an unusually wide range, including ornithology, glacial geology, physical geology, and mineralogy, in all of which he did useful work, thanks to his thoroughness in testing generally accepted explanations, his independent originality, his keen insight, and his artistic skill. Mr. Goodchild served for more than thirty years on the staff of the Geological Survey, being especially engaged in Westmorland and Cumberland, of which counties he made a comprehensive study. While in London, in the winters, he was for some years a valued worker at Toynbee Hall, living beside it in a Whitechapel tenement, and devoting most of his evenings to the organisation of its science classes. For the past fifteen years he was in charge of the geological and mineralogical collections belonging to the Geological Survey in the Edinburgh Museum, and, in connection with his work there, he edited Heddle's "Mineralogy of Scotland," and prepared a careful monograph on the Scotch zeolites. He was also lecturer in mineralogy and geology at the Heriot Watt College. His most important scientific contribution was his paper on the glacial deposits of the Eden Valley, published by the Geological Society in 1875; it will doubtless rank as one of the classics of British glacial geology, though its influence suffered by its publication fifteen years before the original views there expressed could be correctly appreciated.

THE annual meeting of the Royal Society for the Protection of Birds will be held on March 20. The chair will be taken by the Marquess of Granby, G.C.B.

A REUTER message from Lahore, dated March 10, reports that a severe earthquake has occurred in Bashahr, one of the hill States.

THE Berlin correspondent of the *Times* states that Prof. Koch delivered an address on March 7 at the Kaiser Wilhelms Akademie, in the presence of the German Emperor, on the subject of his investigations into the causes and nature of the sleeping sickness in Uganda and East Africa. His studies, he stated, have entirely confirmed the results of the investigations of Dr. Castellani and Col. Bruce, and he has devoted his efforts in particular to investigating the habits of *Glossina palpalis*, the fly by which the infection is conveyed.

IT has been decided to found an International Association of Colonial Agronomy to promote the scientific study of the problems of colonial and tropical agriculture and of the commercial utilisation of natural products. The headquarters of the organisation will be in Paris. The project took shape at the last meeting of the French Association of Colonial Agriculture and Colonisation, when a provisional committee was appointed to organise the International Association, with M. de Lanessan as president and the following vice-presidents:—Great Britain is represented by Prof. Wyndham Dunstan, F.R.S.; Germany, by Prof. Warburg; Brazil, by M. de Piza, Brazilian Minister in Paris; Italy, by Count Sabini; Mexico, by M. de Mier; Holland, by Prof. Greshoff; Portugal, by Prof. Batalha Reis; while France is represented by M. Myre de Vilers, president of the French Geographical Society, Profs. Giard, Müntz, Prillieux and Roux, and MM. Henrique, Tisserand, M. Dybowski, of the French Colonial Office, and Prof. Heim. The first meeting of this committee of initiation will be held this month in Paris.

ON Tuesday next, March 20, Dr. J. E. Marr, F.R.S., will deliver the first of three lectures at the Royal Institution on "The Influence of Geology on Scenery." These are the Tyndall lectures; and on Thursday, March 29, Prof. Bertram Hopkinson will begin a course of three lectures on "Internal Combustion Engines," with experimental illustrations. The Friday evening discourse on March 23 will be delivered by Lord Roberts, on "Imperial Defence"; on March 30 by Prof. Zeeman, on "Recent Progress in Magneto Optics"; and on April 6 by Mr. W. B. Hardy, on "The Physical Basis of Life."

FROM the Egyptian Survey Department we have received a copy of a "Catalogue of the Geological Museum, Cairo," compiled by Dr. W. F. Hume.

IN part vi. of vol. xix. of the Proceedings of the Geologists' Association Mr. M. A. C. Hinton describes the horn-core of a ruminant from the Norwich Crag of Bramerton as representing a new species of gazelle, under the name of *Gazella daviesi*.

THE eyes of deep-sea animals form the subject of an instructive article, by Dr. O. Rabes, of Magdeburg, in the February number of *Himmel und Erde*. Special attention is directed to the strange larval fish recently obtained during the *Valdivia* expedition in the Antarctic, and also in deep water in the Indian Ocean, and described under the name of *Stylophthalmus paradoxus*. In this creature, the systematic position of which is uncertain, the eyes are mounted, crab-fashion, on stalks, the length of which apparently varies according to age.

THE modern practice of supplying hives of bees with new queens at comparatively short intervals renders it essential that a sufficient stock of queen-bees should always be available at a moderate cost to the hive-owner. In America it appears that there are establishments specially devoted to the rearing of queens for sale; but as the price charged is considerable, the entomological section of the Department of Agriculture has issued a Bulletin (No. 55) in which the author, Dr. E. F. Phillips, gives full instructions to enable the hive-owner to breed his own queens.

THE mode in which the American prongbuck, or "antelope," protects its young forms the subject of a beautifully illustrated article, by Mr. H. H. Cross, in the March number of the *Century Illustrated Magazine*. According to the author, the female prongbuck, when about to give birth to offspring, proceeds to the middle of one of the numerous patches of cactus occurring in the haunts of these animals, and there, by means of a series of bounds in the descent from which the cactuses are cut to pieces by her sharp hoofs, clears a space in the centre. Here the young are born, and remain for some time, secure from wolves, which are unable to penetrate the cactus-fence. Danger is, however, experienced from eagles, and to protect their young from these birds the antelope are stated to display great courage.

THE February issue of the *Quarterly Journal of Microscopical Science*, which completes the forty-ninth volume, contains five articles, all devoted to invertebrates, and all of a highly technical nature. The most generally interesting, perhaps, is one by Mr. D. H. Tennent on a cercarian parasite, *Bucephalus haimeanus*, infesting oysters in America, more especially those growing in brackish water. Mr. W. Woodland continues his investigations into the mode of formation of spicules, dealing in this instance with those of the Cucumariæ, and the "plate-and-anchor" type characteristic of Synapta. The maturation of unfertilised eggs of sawflies is discussed by Mr. L. Doncaster, while Prof. J. E. Duerden endeavours to explain the *rôle* of mucus in his favourite corals, and Mr. W. S. Perrin records observations on the structure and life-history of *Pleistophora periplanetae*, a sporozoan parasite of the cockroach.

MISS HARRIET RICHARDSON has prepared a "Monograph on the Isopods of North America," recently published as Bulletin No. 54 of the United States National Museum (pp. liii+727). This work contains careful analytical keys of the families, genera, and species, and a short descriptive account of each species illustrated by text figures of their essential systematic features. The author has evidently spared neither pains nor labour to make her monograph complete, with the result that it must be regarded as an essential part of the outfit of every zoologist who takes an interest in the systematic study of this group of animals.

TUBERCULOSIS in cattle, by Mr. John M. Scott, is the subject dealt with in Bulletin No. 55 of the New Mexico College of Agriculture. Tuberculosis is defined, the extent of the disease, symptoms, and modes of infection are described, and the use of tuberculin is detailed. The Bulletin is illustrated with five capital plates.

A SHORT part continuing the work of the late Mr. G. S. Jenman on the descriptions of West Indian and Guiana ferns has been published. This and future parts will be based on Mr. Jenman's manuscript, and it is anticipated that the work can be carried to completion. In this part the genus Lomaria, containing eight indigenous species, is described.

A DEPARTMENT of forestry has been instituted in connection with the South African College, Cape Town. Provision is being made for ten resident students at Tokai, where the arboretum, a forest museum, and other advantages will furnish excellent facilities for the practical work. The curriculum will consist of a preliminary scientific course in the first year, followed by a two years' forestry course.

A BULLETIN, No. 52, on the agathi plant, issued by the Department of Agriculture, Madras, deals with the cultivation of this plant, *Sesbania grandiflora*, as a support for the betel-vine, the leaves of which form one of the ingredients of the masticatory *pán-sopári*. The agathi plants are topped to prevent them growing too high; the branches

are fed to cattle or used as a green manure for the betel-vines, and the tender leaves and young pods are served as a curry.

IN the January number of the Bulletin of the Department of Agriculture, Jamaica, Mr. W. Harris refers the different varieties of yams cultivated in the island to four species, *Dioscorea sativa*, or negro yam; *Dioscorea alata*, or white yam; *Dioscorea cayennensis*, the yellow or afou yam; and *Dioscorea trifida*, the Indian yam or cush-cush. For the destruction of cotton worm and cassava caterpillar, where Paris green is likely to injure the foliage, or when it may be washed off by rain, Mr. W. Fawcett recommends a wash of lead arsenate.

THE committee entrusted by the Hawaiian Sugar Planters' Association with the control of the experiment station at Honolulu notifies in its report for the year ending September 30, 1905, that a division of pathology and physiology has been formed under the directorship of Dr. N. A. Cobb, in addition to the division of agriculture and chemistry and a division of entomology. The work of the last named has been chiefly devoted to the study and breeding of insects that prey upon cane leaf-hoppers. Among the bulletins prepared by the agricultural division, the most important presents a review of fertiliser experiments extending over eight years. A bulletin on the inspection and disinfection of cane cuttings is the first publication of the new department. The methods of preparing Bordeaux mixture are discussed, and suggestions are made for treating cuttings on a large scale.

IN the *Engineering and Mining Journal* (vol. lxxxi., No. 7) is the first authoritative statement of the discoveries in a new gold field at Manhattan, in Nevada, which is at present attracting much attention. The veins, which appear to be extraordinarily rich in gold, occur in limestone in the vicinity of rhyolite.

THE preliminary returns issued by the Home Office show that the production of coal in Great Britain in 1905 amounted to 236,111,150 tons, or 3,699,366 tons more than in 1904. The number of persons employed at mines under the Coal Mines Regulation Act was 858,373, or 1·28 per cent. more than in 1904. The production of copper ore was 7115 tons, that of lead ore 27,482 tons, and that of zinc ore 23,647 tons. Statistics of the production from open workings are not yet available, so that details of the production of other minerals are incomplete.

IN a paper on the screw propeller controversy published in the Transactions of the Institution of Engineers and Shipbuilders in Scotland (vol. xlix., part iv.), Mr. James Holden endeavours to demonstrate the true action of the propeller, and to show that Rankine's theory is wholly erroneous. He considers that none of those writers who have adopted the Rankine theory, in whole or in part, are able to guide others, either scientifically or practically, in the construction or use of screw propellers.

THE latest addition to technical periodical literature is a bi-monthly journal entitled *Concrete and Constructional Engineering*. It has been founded with the object of meeting the growing demand for information regarding concrete and reinforced concrete. The first issue (March) covers 74 octavo pages, and is admirably illustrated. It contains articles by Lieut.-Colonel J. Winn, on the advent of the concrete age; by Mr. W. N. Twelvetrees, on steel skeleton construction; by Mr. C. F. Marsh, on reinforced concrete foundations of buildings; by Mr. C. H. Desch, on the setting of Portland cement; by Mr. B. H. Thwaite, on the preservation of iron and steel against corrosion; and a digest of recent publications on concrete and constructional engineering.

IN the Journal of the Franklin Institute of Philadelphia (vol. clxi., No. 2) Mr. E. Keller describes and illustrates a number of improved methods and apparatus introduced in the newly equipped assay laboratory of the Anaconda Copper Mining Co. in Baltimore. The chief duty of the laboratory is to determine the values of copper, silver, and gold in crude copper, and the equipment is probably superior to any elsewhere. Stirring and filtering are effected by machines, and in assaying operations everything is handled in sets. Much labour has been saved, breakage of expensive glass-ware has been very largely eliminated, and the time of the furnace work and the consumption of gas have been much reduced.

THE modern locomotive question is chiefly one of boilers. The great increase in the size of boilers and in the pressures carried, which has taken place during the past few years, has necessitated the re-consideration of the principles of design, which had been settled with comparatively small boilers carrying low pressures. The paper on large locomotive boilers read by Mr. G. J. Churchward before the Institution of Mechanical Engineers on February 16 is therefore opportune. He gives illustrations of various locomotive boilers, and shows how much more heating surface is now provided for a given area of cylinder than was formerly considered necessary. The higher pressures now common have undoubtedly produced much more efficient locomotives, both in respect of hauling power and of coal consumption. The improvement has been very marked with every increment of pressure right up to 227 lb. carried by the new De Glehn compound locomotives of the Great Western Railway.

THE report of the superintendent of the Meteorological Department of Ceylon for the year 1904 shows that 1904 must be reckoned as one of the "dry" years; the rainfall was considerably below the average over the greater portion of the island, especially in the north and west, where deficiencies of 10 to 15 inches were recorded in several districts. In May, however, the excess of rainfall caused destructive floods; in the Kelani Valley alone 124 square miles were covered, involving great loss of property, the water being higher than at any time since 1871. The climate varies considerably in different parts of the island; in the lowlands it is tropical, but in the high parts of the interior it is equal to that of many parts of Europe. The highest shade temperature recorded in 1904 was 99°·8 at Anuradhapura, in May, and the lowest, 28°·2, at Nuwara Eliya, in February; this is the lowest reading on record. Temperatures exceeding 100° have been recorded in some years; the highest on record was 103°·7, at Trincomalee, in May, 1890.

IN the February number of the *Bulletin de la Société astronomique de France* MM. Flammarion and Loisel publish the annual summary of the climatology of 1905 as recorded at the Juvisy Observatory. It appears that a notable feature of the atmospheric pressure was its extraordinary irregularity. With the exception of February, March, and July, the mean monthly temperatures were below the normal. October was the coldest recorded in the neighbourhood of Paris since 1757, excepting the October of 1887. In discussing the solar-radiation record, attention is directed to the abnormal cloudiness of 1905 and to its coincidence, in regard to time, with the large number of sun-spots. The writers suggest that the

abnormal rainfall was caused by increased evaporation taking place in the tropics, and connect this, and the cyclones, earthquakes, and volcanic eruptions which took place during the year, with the increased solar activity.

MESSRS. LANDER AND SMITH, of Canterbury, have sent us their catalogue of new meteorological instruments. Mr. Lander has given much attention to the problem of providing satisfactory self-recording instruments at popular prices, and has devised new forms of apparatus for registering wind-force and direction, rainfall, sunshine, air pressure, temperature, and humidity. The advantages of using instruments which will give a continuous record are obvious; the desideratum is, of course, that they shall give trustworthy records. The anemometer appears to be a modification of the well known Dines's pressure tube anemometer, with the addition of an arrangement for recording upon a separate paper the direction of the wind as well as its force. The sunshine recorder is of the photographic type, but, unlike other photographic recorders, it makes use of a clock for controlling the admission of the light, so that the record is for mean time instead of for local apparent time as in all other forms. As an example of the efficient working of the different apparatus, Mr. Lander has sent us some reduced curves, here reproduced, of the sharp and sudden thunderstorm of February 8. They clearly show an abrupt drop in the maximum force of the wind from about forty miles an hour to almost a calm, and an equally sudden shift in direction from W.S.W. to N.W. The barometer, which had been falling steadily all day, rose abruptly a tenth of an inch, with a simultaneous drop of 12° in temperature and a fall of rain (or snow) of about a quarter of an inch in a few minutes. During the storm no less than six windmills were struck by lightning near Canterbury, where the records were obtained.

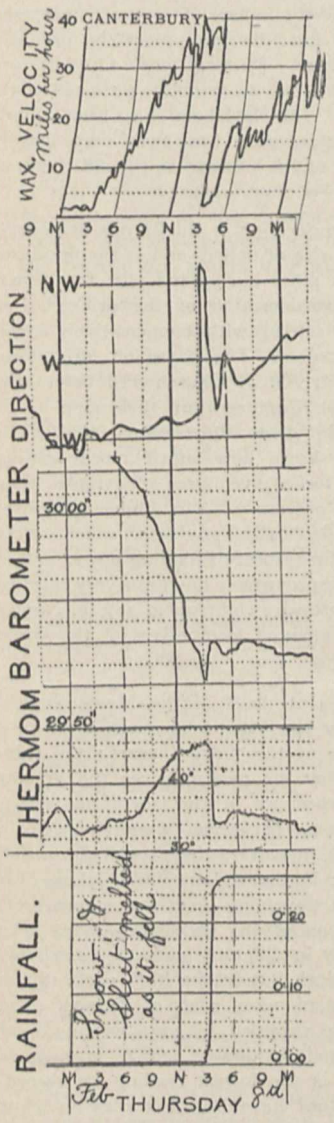

FIG. 1.—Reduced copies of records from self-recording instruments, February 8.

UNDER the title of "An American Laboratory for Experimental Phonetics in Germany," Major H. vom Hagen describes the experiments carried out with the aid of the Carnegie Institution by Prof. E. W. Scripture, first in Munich and later on in Berlin. The paper is illustrated by tracings of phonographic records, and is published in *Prometheus*.

IN the Bulletin of the French Physical Society, No. 235, it is stated that M. Ernest Bichat, who died towards the end of last year, was the author of a number of papers on magnetic rotatory polarisation in gases, and in conjunction with M. Blondlot on oscillating discharges, on Kerr's phenomenon, and on the cylindrical absolute electrometer. He was dean of the faculty of science at Nancy.

A PORTRAIT of Prof. Georg Cantor, of Halle, is published in the January number of the *American Journal of Mathematics*. Cantor's researches on the theory of multitudes and the continuum earned for him the Royal Society's Sylvester medal in 1904, and, speaking of this theory, Dr. Pittard Bullock writes:—"Herr Georg Cantor is looked upon as the discoverer and creator, and in rare cases has a discovery been attributed to one man alone with more readiness." We extract this quotation from a thesis on "The Power of the Continuum." In this thesis Dr. Pittard Bullock gives a proof that the power of the continuum is the lowest but one, or, in other words, that there is no multitude the power of which is lower than that of the continuum but greater than that of a dinumerable multitude.

TWO papers on the vibrations and stresses in shafting have recently appeared. One, forming the fourth of the technical series of the Drapers' Company Research Memoirs, is based on a paper written by Prof. Karl Pearson in 1885, and deals with torsional vibrations treated by Saint Venant's methods; it is illustrated by a large number of lithographed diagrams. The other is a reprint from the Minutes of Proceedings of the Institution of Civil Engineers of a joint paper by Dr. Chree, F.R.S., Captain H. R. Sankey, and Mr. W. E. W. Millington, dealing in the main with the dangers arising from synchronism between the periods of free vibration of the loaded shaft and the periods of fluctuation of the force or torque applied to it. In a large class of practical applications we have to deal with shafts carrying such loads as flywheels, where the kinetic energy of the shaft itself can be neglected, for purposes of rough calculation, in comparison with that of the loads.

IN a paper on the future of statistics, published in the *Statistical Journal* (lxviii., 4), Mr. J. G. Mandello directs attention, among other matters, to the need of organisation in the publication of statistics. The paper deals, in a large measure, with the tendency to chaos resulting from the ever increasing production of printed literature on statistics. It is becoming more and more difficult as time goes on for a busy man to obtain the information which he requires as to the actual state of knowledge in any branch of statistical science, and the mere consulting of voluminous masses of literature more often than not fails to give the inquirer the information which he requires, and, indeed, is not unlikely to end in the re-publication of work already done. Mr. Mandello's remedy is to limit the output of printed matter, and to devote the money thus saved to the establishment of central bureaux where papers of a highly specialised character could be conserved, in type-written form, for the use of future inquirers, a staff of officials being appointed for the purpose of giving the necessary assistance. A plan of this kind is already working in connection with the Geological Survey of Belgium. Instead of printing maps, which soon become

superseded, they keep large manuscript maps on which the newest details are at once entered, and any specialist can obtain on application a drawn copy of the map of any region, which is naturally quite correct and up to date. A side-issue, which the author does not consider, is whether people would rush into archives with the same eagerness with which they now rush into print, and whether it might be better if they did not.

THE great alteration which occurs in the fluorescence spectrum of sodium vapour when the wave-length of the exciting light is changed is the subject of a brief communication by Prof. R. W. Wood in No. 4 of the *Physikalische Zeitschrift*. Three kinds of monochromatic light, having wave-lengths 5085, 4799, and 4676 respectively, and generated by a cadmium arc lamp of the Heraeus type, were employed in the experiments.

THE lecture delivered by Prof. Emil Fischer before the German Chemical Society on January 6, and having for its subject his recent researches on amino-acids, polypeptides, and the proteids, is published in the current number of the *Berichte* (No. 3). The lecture covers an extraordinarily wide field, and contains a *résumé* of the experimental results obtained during the past five years by Prof. Fischer and his colleagues. A briefer and more general summary of recent work tending towards the synthesis of proteid material is contributed by Prof. Maillard to the *Revue générale des Sciences* for February 15.

IN the Proceedings of the American Academy of Arts and Sciences (vol. xli., No. 19) Messrs. Gilbert N. Lewis and Plumer Wheeler have studied the electrical conductivity of solutions of potassium iodide in liquid iodine. Such solutions are found to conduct electricity as well as the best aqueous solutions, but they present certain interesting anomalies. In dilute solution the molecular conductivity increases linearly with the concentration, rising to a maximum and then falling as the concentration increases; the phenomena show a certain analogy with the deviations from Ostwald's dilution law in aqueous solutions. The temperature coefficient of conductivity is, moreover, negative for dilute solutions, but with increasing concentration it passes through zero and becomes positive.

ALTHOUGH several attempts have been made to prepare selenium iron alums of the type

$$Fe_2(SeO_4)_3,M_2SeO_4,24H_2O,$$

no compound of this group has yet been obtained. In the February number of the *Gazzetta* Dr. Cesare Roncagliolo describes the method by which he has succeeded in preparing the rubidium and cæsium salts,

$$Fe_2(SeO_4)_3,RbSeO_4,24H_2O, \quad Fe_2(SeO_4)_3,CsSeO_4,24H_2O.$$

As anticipated, these salts were found to be isomorphous with the ordinary alums. As the rubidium and cæsium salts melt at about 40° C. and 55° C. respectively, it may be inferred by analogy with the other alums that the corresponding potassium and sodium alums melt below 0° C. If this is the case, an explanation is afforded of the failure hitherto experienced to prepare these salts.

A SIXPENNY edition of Lord Avebury's "Beauties of Nature and the Wonders of the World we Live in" has been published by Messrs. Macmillan and Co., Ltd.

MESSRS. PERCIVAL MARSHALL AND CO. have published, at 3*d*. net, a pamphlet by Mr. A. H. Stanley dealing with "Patents to Inventors." A chapter on patent agents is included.

MESSRS. ARCHIBALD CONSTABLE AND CO., LTD., have published a second edition of Mr. Bertram Blount's "Practical Electro-chemistry," the first issue of which was reviewed at length in NATURE of April 18, 1901 (vol. lxiii., No. 1642). The present edition has been revised and brought up to date. The revision of the section on organic electrochemistry has been done with the assistance of Dr. Mollwo Perkin.

THE twenty-first session of the London Geological Field Class, conducted by Prof. H. G. Seeley, F.R.S., will be opened on Saturday, April 28, by an excursion from Nutfield to Redhill, for the observation of parallel escarpments. In addition to the Saturday afternoon excursions, vacation visits extending over two or three days will be made with the view of examining a Tertiary locality in the Hampshire basin, the Cretaceous rocks of north-west Norfolk, Devizes, or Folkestone; the oolites of Swindon or Cheltenham; and the primary rocks of Clifton, the Mendip Hills, the Welsh border, or Leicestershire. The secretary of the class is Mr. J. W. Jarvis, St. Mark's College, Chelsea, S.W.

A COPY of the report of the Felsted School Scientific Society for the year 1905 has been received. The organisation of the members of the society into four sections has now been in working order for two years, and has led to sound collective work, and in some cases originated good individual practical study. Special encouragement is given to the individual efforts of members. Like most similar organisations, this society is greatly in need of funds to supply necessary instruments, specimens, and apparatus to carry out the observations and other work planned by the directors. Men of science could encourage the voluntary study of science in secondary schools by presenting duplicate specimens and unused instruments to school scientific societies. The report shows that a sustained effort is being made at Felsted School to create active interest in the study of science.

MESSRS. ISENTHAL AND CO. have just issued new catalogues dealing respectively with mercury vapour lamps for all purposes, and with electric heating and cooking appliances. The mercury vapour lamps are at present made in three standard lengths of 18 inches, 26 inches, and 38 inches, so as to utilise fully the various standard voltages from 100 volts to 250 volts. At present the lamps are available only for direct current, though they are recommended for use on alternating current in connection with the Grisson rectifier and electrolytic condenser. The catalogue of heating and cooking apparatus is excellently illustrated, and is divided into two sections. The first includes appliances for domestic purposes and use in hotels and clubs, while the second is concerned with technical apparatus for use in factories and laboratories.

OUR ASTRONOMICAL COLUMN.

COMET 1905*c*.—Giacobini's comet (1905*c*) has now become much fainter, but does not set until some 3½ hours after sunset. A further instalment of Herr Wedemeyer's ephemeris is given below:—

Ephemeris 12h. M.T. Berlin.

1906		α (true) h. m. s.	(δ true) ° ′	log *r*	log Δ	Brightness
Mar. 16	...	2 45 1	... 1 49	... 0·1371	... 0·2718	... 0·51
19	...	2 54 0	... 2 59			
22	...	3 2 28	... 4 5	... 0·1714	... 0·3058	... 0·37
25	...	3 10 28	... 5 5			
28	...	3 18 6	... 6 1	... 0·2022	... 0·3375	... 0·28
31	...	3 25 21	... 6 53			

As will be seen from the ephemeris, the comet is still traversing the constellation Cetus towards Taurus, and

will enter the latter about March 27. On March 21 it will be only about 2m. directly east of α Ceti.

COMET 1906*b*.—The comet discovered by Dr. Kopff will evidently not become an object of popular interest, for it passed perihelion at least two months ago, and is now fading rapidly in brightness.

Below is given a set of elements and part of an ephemeris published by Herr M. Ebell in Circular 86 of the Kiel Centralstelle :—

Elements.

T = 1906 January 4·1289 Berlin.
∞ = 138° 25′·1
Ω = 328° 24′·2 } 1906·0
i = 0° 53′·5
log *q* = 0·03508

Ephemeris 12h. M.T. Berlin.

1906	α	δ	log Δ	Brightness
	h. m. s.	° ′		
Mar. 15 ...	11 31 20 ...	+1 57 ...	9·7514 ...	0·54
19 ...	11 30 10 ...	+2 2 ...	9·7842 .	0·44
23 ...	11 29 17 ..	+2 6 ...	9·8166 ...	0·36
27 ...	11 28 44 ...	+2 9 ...	9·8486 ...	0·29

A set of elements computed from later observed positions by Mr. Champreux gives the date of perihelion as December 25·17 Greenwich.

REMARKABLE VARIATION IN THE SPECTRUM OF ζ BOÖTIS.—In No. 4067 of the *Astronomische Nachrichten* Drs. H. Ludendorff and G. Eberhard direct attention to some remarkable variations which took place very suddenly in the spectrum of the double star ζ Boötis.

A spectrogram taken on June 3, 1905, showed a number of bright emission bands undoubtedly similar to those seen in the spectra of new stars, but another spectrum taken on June 5 showed no trace of these.

On looking over previous spectra obtained at the Potsdam Observatory on June 3, 4, and 26, 1902, respectively, only the hydrogen series lines, the calcium line λ 3934, the magnesium line λ 4481, and possible traces of other absorption lines could be detected. No bright bands were present.

The star is a well known double, classed as a "Sirian" star by Sir Norman Lockyer, as belonging to class I.*a*2 by Prof. Vogel, and as a class A star in the Draper Catalogue.

The question of the variability of the relative brightness of the two components has been much discussed, but was affirmed by W. Struve, Sir W. Herschel, and O. Struve.

A BRILLIANT FIREBALL.—In No. 368 of the *Observatory* Mr. Denning has brought together a large number of observations of a magnificent fireball which was seen in Scotland and the northern counties of England on December 30, 1905.

The meteor appeared at about 4h. 26m., swelled out into a disc, which one observer states was about half the size of the moon, and disappeared when about 10°–15° above the horizon. The trail left by the meteor lasted for about twelve or thirteen minutes according to most observers, and during that time was contorted into a variety of peculiar forms.

From the insufficient data yet to hand, Mr. Denning supposes that this object was a very late ε Arietid, having its radiant point at about 40°+23°, and on this supposition the height of the meteor works out at sixty-seven miles over Thornhill, in Dumfries, to twenty-seven miles over a point some six miles south of Arran. The earth-point would be about ten miles N.E. of Rathlin.

Thus the length of the path would be seventy-two miles and the velocity about fifteen miles per second.

In the same journal (Nos. 367 and 368) there is published an interesting discussion of the 1905 Bielid meteors by Prof. A. S. Herschel.

OBSERVATIONS OF PHŒBE DURING 1905.—A number of photographic measures of Phœbe, made during the period May 9 to December 14, 1905, are given in Circular 109 of the Harvard College Observatory. The usual exposure given to each photograph was two hours, and only very faint images of the satellite were obtained; thus they were very difficult to measure exactly, and the resulting residuals are somewhat large.

It is seen from the measures that Phœbe attained its maximum distance from Saturn, viz. 36′·4, on September 5. The average differences between the observed distances and declinations and those computed from the ephemeris published in vol. liii. of the Annals (p. 141) were about −0′·2 and −0′·6 respectively.

THE LEEDS ASTRONOMICAL SOCIETY.—The Journal and Transactions of the Leeds Astronomical Society (No. 12) has just been received, and contains a number of interesting papers which were read before the society during 1904.

In addition to these there is a *résumé* of the society's work during the year, as shown by a number of communications to various journals.

Non-members may obtain the journal for 1*s*. 6*d*. from Messrs. Jackson and Son, Leeds.

NEW MAGAZINES OF BIOLOGICAL CHEMISTRY.

JOURNALS dealing with the chemical aspects of physiological and pathological research have long been current in Germany; but up to the present time English-speaking workers have had to rely on periodicals dealing with all branches of physiology and pathology for the publication of their results. This is by no means disadvantageous to the readers of such journals, for over-specialisation has its drawbacks. But with the ever increasing activity in the biochemical field of research, the need has for long been felt of a special journal, and we have to chronicle the advent of one—the *Bio-chemical Journal*—which supplies the need, under the editorship of Prof. Benjamin Moore and Dr. Whitley, of the Liverpool University. In America also a similar want has been met by the issue of the first numbers of what is there called the *Journal of Biological Chemistry*, which is edited by Prof. Christian Herter, of New York, and Prof. J. J. Abel, of Baltimore.

The prefix *bio* and the adjective *biological* indicate a wider outlook than was implied by the older expression physiological chemistry, for there are chemical matters which have bearings, not only on physiology, but on botany, zoology, and pathology; and, indeed, this broad scope is already recognisable in the early issues of both the journals mentioned. It will be sufficient to take the English journal as an example. In the first number, just to hand, there is a paper by Mr. Joseph Barcroft dealing with the oxygen tension in the salivary glands and saliva, and throwing new light on the question of internal respiration in general. The professor of botany at Liverpool, Mr. Harvey Gibson, contributes an article on the physiological properties of West Indian boxwood, so much used now by the shuttle-makers of the north. The cardiac symptoms noticed in many of these workers are shown to be due to an alkaloid in the wood, which is dissolved out by the perspiration on the hands of the workpeople, and slowly absorbed into the system. Drs. Edie and Whitley describe methods for estimating the daily gain or loss of fixed alkali from the body, and the organic acids in the urine; the application of their results in the case of diabetes is pointed out. It was previously known that in acid poisoning the body protects itself by an increased formation of ammonia from urea; it is now shown that there is a similar protective mechanism at work against excess of alkali in the production of an increased amount of organic acids from carbohydrates. The last paper, by Drs. Moore, Edie, and Abram, more directly illustrates the application of chemical studies to the elucidation of disease. They find that the administration of a neutralised acid extract of the duodenal mucous membrane counteracts diabetes in the few cases examined up to the present. The explanation advanced of the benefit is that the extract stimulates the pancreas to form that internal secretion which regulates carbohydrate metabolism, but which is apparently in abeyance in the diabetic state.

Enough has been said to show the interesting and important kind of material at hand, and we wish our two new contemporaries every success in the future.

FORESTRY IN THE UNITED STATES.

THE United States Geological Survey has already issued in the form of reports various papers dealing with the conditions of the localities in the more important forest reserves. Professional Paper No. 29 of the forestry series of the department deals with the forest conditions in the

FIG. 1.—Cultivated Valley in the Woodland Area of the Lincoln Forest Reserve, New Mexico.

Absaroka division of the Yellowstone Forest Reserve, Montana, and the Livingstone and Big Timber Quadrangles. This report first treats of the location, extent, and topography of the Yellowstone Reserve. The forest itself is almost wholly coniferous, consisting of pines, spruce, silver and Douglas firs. A most interesting account is given concerning the distribution of these species, especially in regard to altitude and aspect. As regards the ages of the trees the greatest diversity prevails. Age classes occur, varying from 15 to 20 years, 75 to 100 years; also stands from 200 to 300 years old are represented, this condition of things having been brought about by fire, the different age-classes corresponding to burns of different periods. The character and volume of merchantable timber are next carefully gone into. These naturally vary according to the species of tree, as well as the altitude and aspect in which it is growing, and the report brings out very interesting facts in this connection.

Like other forest reserves, the present one is divided into a number of smaller divisions called townships, which are carefully described in detail. Two useful land classification maps are appended.

A report of the forest conditions in the Little Belt Mountains Forest Reserve, Montana, and the Little Belt Mountains Quadrangle, forms Paper No. 30 of the same series. Here again the principal species are conifers; but the chief value of the forest lies in its effect on the conservation and regulation of the rainfall, hence it is more in the nature of a protection forest than one preserved for its timber production.

The forest conditions of the Lincoln Forest Reserve, New Mexico, are described in Paper No. 33. This reserve was created by proclamation of the President in 1902. The description of the included area is again given by townships. The area is more or less mountainous, and, as a natural consequence, the woodland growths are found to be divided into zones determined by altitude. A very interesting graphical representation of the various zones and species occurring in them is included. Short descriptions of the different species of trees are given, among which the yellow pine (*Pinus ponderosa*) is the chief timber tree. The conservation of trees in the reserve is of enormous importance in connection with the irrigation of cultivated lands in its neighbourhood, or vast areas that could be used for agricultural purposes if a regular supply of water were secured. Artificial tanks are at present employed for the storage of intermittent surface flows of water to be used for domestic purposes and irrigation.

Paper No. 39 consists of a report of the forest conditions of the Gila River Forest Reserve, New Mexico. This reserve was established by President McKinley in 1889. The reserve includes several prominent mountain ranges, and on the whole the area is well watered, the streams from the mountains carrying a considerable flow to a long distance beyond the forest regions. The reserve is traversed by fairly good roads and trails which follow the valleys. Agriculture is extensively carried on along San Francisco River, but not to such an extent along Gila River. The settlers formerly found a very ready market for their produce in the mining camps at Cooney and Mogollon, but several of these camps have been deserted within the last year or two, and the market has become considerably restricted. Grazing is an important industry in this region, but will require careful attention and supervision to prevent the inevitable result of over-

FIG. 2.—Artificial "Tank" for Water Supply. Lincoln Forest Reserve, New Mexico.

stocking, as this not only leads to a total destruction of the grass roots, but also gives rise to drought at one period and disastrous flooding at another. The yellow pine is found to grow very well in this region, and will probably form the principal species in re-stocking the land when the older timber is removed.

FORTHCOMING BOOKS OF SCIENCE.

MESSRS. BAILLIERE, TINDALL AND COX'S list includes:—"Applied Bacteriology," by Prof. R. T. Hewlett and C. G. Moor, illustrated; "Laboratory Manual of Physiology," by Dr. F. C. Busch; "Trypanosomes and Trypanosomiasis," by Laveran and Mesnil, translated and edited by Dr. D. Nabarro; "Practical Agricultural Chemistry," by F. Robertson; "Röntgen Rays in General Practice," by R. H. Cooper; and a new edition of "Philosophy of Voice," by C. Lunn.

Messrs. A. and C. Black promise:—"A Treatise on Zoology," edited by Prof. E. Ray Lankester, F.R.S., part v., "Mollusca," by Dr. P. Pelseneer, illustrated.

Messrs. Gebrüder Borntraeger (Berlin) give notice of:—"Hygienisches Centralblatt," edited by Dr. P. Sommerfeld; "Zeitschrift für Gletscherkunde," edited by Prof. E. Brückner; "Tabulae botanicae," edited by Drs. E. Baur and Jahn; "Kryptogamenflora der Mark Brandenburg," Band ii., *Laubmoose*; "Forstbotanisches Merkbuch," iv., *Schleswig-Holstein*; "Allgemeine Botanik," by Prof. Warming; and "Geschichte Roms," by Prof. Drumann, Band iii.

The Cambridge University Press list includes:—"Cambridge Tracts in Mathematics and Mathematical Physics," No. 3, "Quadratic Forms and their Classification by Means of Invariant Factors," by Prof. T. I'A. Bromwich; "Trigonometry for Beginners," by J. W. Mercer. The following are in preparation:—"The Definite Integral, its Meaning and Fundamental Properties," by Dr. E. W. Hobson, F.R.S.; "Singular Points and Asymptotes of Plane Curves," by Prof. C. A. Scott; "The Axioms of Geometry," by Dr. A. N. Whitehead, F.R.S.; and "The Eikonal and its Application to Optical Instruments," by E. T. Whittaker, F.R.S.

Messrs. J. and A. Churchill give notice of:—"A Short Practice of Medicine," by Dr. R. A. Fleming; "Preservatives in Food and Food Examination," by Dr. J. C. Thresh; "Essentials of Surface Anatomy," by C. R. Whittaker; "A Manual of Midwifery," by Dr. T. W. Eden; "Clinical Applied Anatomy; or, the Anatomy of Medicine and Surgery," by C. R. Box and W. M. Eccles; "A Manual of Pathology, General and Special," by Prof. R. T. Hewlett; "A Manual of Prescribing," by Prof. C. R. Marshall; "Spinal Curvature," by H. R. H. Bigg; "Pharmaceutical Latin Grammar; or Prescriptions, how to Write and Read Them," by R. R. Bennett; and new editions of "A System of Dental Surgery," by C. S. Tomes and W. S. Nowell; and "Minor Surgery and Bandaging," by B. Pollard.

Messrs. A. Constable and Co., Ltd., will publish:—"Radio-active Transformations," by Prof. E. Rutherford, F.R.S., illustrated; "The Integrative Action of the Nervous System," by Prof. C. S. Sherrington, F.R.S., illustrated; and "Physiology of the Nervous System," by J. P. Morat translated and edited by Dr. H. W. Syers, illustrated.

Messrs. J. M. Dent and Co. direct attention to:—"English Men of Science," edited by Prof. J. R. Green, F.R.S.—"Herbert Spencer," by Prof. J. A. Thomson; "Priestley," by Dr. T. E. Thorpe, C.B., F.R.S.; "George Bentham," by B. D. Jackson; "Huxley," by Prof. J. R. A. Davis; "Sir Wm. Flower," by R. Lydekker, F.R.S. Of Dent's Mathematical and Scientific Series, the following are in preparation:—"Geometrical Conics," by Profs. G. H. Bryan, F.R.S., and R. H. Pinkerton; "Analytical Conics," by Prof. C. A. Scott; "Mechanics," by C. S. Jackson and R. M. Milne; "Trigonometry," by C. Hawkins; "Algebra," by Prof. H. W. Ll. Tanner, F.R.S., and W. J. Greenstreet; "Practical Mathematics," by J. E. Boyt; "Light," by F. E. Rees; "A French Scientific Reader," compiled by W. J. Greenstreet; "A German Scientific Reader," compiled by C. R. Dow; and "Mathematical Tables," by Prof. G. H. Bryan, F.R.S.

Mr. Gustav Fischer (Jena) announces:—"Flora, oder Allgemeine Botanische Zeitung," Jahrgung 1906, edited by Prof. K. Goebel, Heft i., illustrated; "Klinisches Jahrbuch," fünfzehnter Band, zweites Heft, illustrated; "Physiologie des Menschen," by Prof. L. Luciani, German translation, Band ii., illustrated; "Das Rettungs- und Krankenbeförderungswesen im deutschen Reiche," by Prof. G. Meyer, Bildet zugleich den dritten Ergänzungsband zum klinischen Jahrbuch, illustrated; "Résultats scientifiques du Congrès international de Botanique, Wien, 1905," illustrated; "Die Wirbeltiere Europas mit Berücksichtigung der Faunen von Vorderasien und Nordafrika," by Prof. O. Schmiedeknecht; "Vegetationsbilder," edited by Profs. G. Karsten and H. Schenck, dritte Reihe, Heft vi.: Emerich Zederbauer, Vegetationsbilder aus Kleinasien, illustrated; "Verhandlungen der deutschen pathologischen Gesellschaft," edited by G. Schmorl, neunte Tagung, gehalten in Meran vom 25 bis 29 September, 1905, illustrated; "Gesammelte Abhandlungen," Band iv., Sozialpolitische Schriften, by Prof. E. Abbe; and new editions of "Lehrbuch der Entwicklungsgeschichte des Menschen und der Wirbeltiere," by Prof. O. Hertwig, illustrated; "Tabellen zur Gesteinskunde für Geologen, Mineralogen, Bergleute, Chemiker, Landwirte und Techniker," by Prof. G. Linck, illustrated; "Einführung in das Studium der Malariakrankheiten," by Dr. R. Ruge, illustrated; "Anatomische, physiologische und physikalische Daten und Tabellen zum Gebrauche für Mediziner," by Prof. H. Vierordt; and "Lehrbuch der allgemeinen Pathologie und der pathologischen Anatomie," by Prof. E. Ziegler, Band ii., Lehrbuch der speziellen pathologischen Anatomie, edited by Drs. E. Gierke and K. Ziegler, illustrated.

Messrs. Gauthier-Villars (Paris) promise:—"Guide du Météorologiste amateur," by Loisel; "Leçons sur le Séries trigonometriques," by Lebesque; "La Mécanique des Phénoménes fondée sur les Analogies," by Petrowitch; and "Les Conserves alimentaires," by Rocques.

Messrs. Charles Griffin and Co., Ltd., announce:—"The Theory of the Steam Turbine, a Treatise on the History, Development, and Principles of Construction of the Steam Turbine," by A. Jude, illustrated; "Present-day Shipbuilding: abridged from 'Steel Ships,' Revised and Specially Arranged to Meet the Requirements of Shipyard Students, Ships' Officers, and Engineers for their Respective Examinations," by T. Walton, illustrated; "Motor-car Mechanism and Management," by W. P. Adams, in three parts, illustrated, part ii., the Electrical Car, and part iii., the Steam Car; "General Foundry Practice: a Practical Handbook for Iron, Steel and Brass Founders, Metallurgists, and Students of Metallurgy," by A. C. McWilliam and P. Longmuir, illustrated; "The Elements of Chemical Engineering," by Dr. J. Grossmann, illustrated; "Locomotive Compounding and Superheating," by J. F. Gairns, illustrated; "Peat: its Use and Manufacture," by P. R. Björling and F. T. Gissing, illustrated; "The Clayworker's Handbook, an Epitome of the Materials and Methods Employed in Brickmaking and Pottery," by the author of "The Chemistry of Clayworking," illustrated; "Paper Technology, an Elementary Manual on the Manufacture, Physical Qualities, Chemical Constituents, and Testing of Paper and Paper-making Fibres, with Selected Tables for the Use of Publishers, Stationers, and Others," by R. W. Sindall, illustrated; "Lessons on Sanitation," by J. W. Harrison, illustrated; "Toxines and Antitoxines," by Dr. C. Oppenheimer, translated from the German by C. A. Mitchell, with notes and additions by the author, since the publication of the German edition; "The Treatment of the Diseases of the Digestive System," by Prof. R. Saundby; and new editions of "Chemistry for Engineers and Manufacturers," by B. Blount and A. G. Bloxam, vol. i., the Chemistry of Engineering, Building, and Metallurgy; "Petroleum and its Products, a Practical Treatise," by Sir B. Redwood, illustrated; and "Aids in Practical Geology: with a Section on Palæontology," by Prof. G. A. J. Cole, illustrated.

Messrs. Hodder and Stoughton give notice of:—"A History of Egypt from the Earliest Times to the Persian Conquest," by Prof. J. E. Breasted, illustrated; "Every Man's Book of Garden Difficulties," by W. F. Rowles, illustrated; "Every Man's Book of Garden Flowers, with Short Directions for their Culture," by J. Halsham, illustrated; and "A Nature Reader for Senior Students, being an Anthology of the Poetry of Nature," edited by the Hon. Sir John Cockburn, K.C.M.G., and E. E. Speight.

Messrs. Hutchinson and Co. announce:—"Liberia, the Negro Republic in West Africa," by Sir Harry Johnston, G.C.M.G., K.C.B., &c., illustrated; Darwin's "Origin of Species," edited by J. W. Mathews; and Waterton's

"Wanderings in South America," with notes, &c., by W. A. Harding.

In Mr. John Lane's list are:—"Bombay Ducks: an Account of Some of the Everyday Birds and Beasts found in a Naturalist's El Dorado," by D. Dewar, illustrated; "The Wild Flowers of Selborne and Other Papers," by the Rev. Canon Vaughan, illustrated. New volumes in the "Practitioners' Library," edited by H. Roberts: "Forms of Paralysis," by Dr. J. S. Collier; "X-Rays in General Practice," by Captain A. E. Walter. New volumes in the Country Handbooks, edited by H. Roberts: "The Stable Handbook," by T. F. Dale, illustrated; "The Country Cottage," by G. L. Morris and E. Wood, illustrated. New volumes in the Handbooks of Practical Gardening: "The Book of Rarer Vegetables," by G. Wythes and H. Roberts; "The Book of the Winter Garden," by D. S. Fish; "The Book of Market Gardening," by R. L. Castle, illustrated; and a new edition of "Rifle and Romance in the Indian Jungle: being the Record of Thirteen Years of Indian Jungle Life," by Captain A. I. R. Glasfurd, illustrated.

Mr. T. Werner Laurie will publish:—"Fishing for Pleasure and Catching It," by E. Marston, with two chapters on Salmon and Trout Fishing in North Wales by R. B. Marston, illustrated; and "Modern Medicine for the Home," by E. Walker.

Among Messrs. Crosby Lockwood and Son's forthcoming books we notice:—New editions of "The Art of Leather Manufacture," by A. Watt; "Colliery Working and Management," by H. F. Bulman and R. A. S. Redmayne, illustrated; "A Handybook for Brewers," by H. E. Wright; and "Sheet Metal Worker's Instructor," by R. H. Warn and J. G. Horner, illustrated.

Messrs. Longmans and Co.'s list includes:—"Mammals of Great Britain and Ireland," by J. G. Millais, vol. iii., completing the Rodentia with the Hares and the Rabbit; it will also contain the Cervidæ (the Deer family), the Bovidæ (the Oxen), and the Cetaceæ (Whales), illustrated; "Health of Our Children in the Colonies, a Book for Mothers," by Dr. L. A. Robinson; "Plants and their Ways in South Africa," by B. Stoneman; "Design of Lathes for High Speed and Heavy Cutting," by J. T. Nicolson and D. Smith; "Practical Manual of Tides and Waves," by W. H. Wheeler, illustrated; "Scientific Principles of Wireless Telegraphy," by Prof. J. A. Fleming, F.R.S.; "Modern Steam Road Wagons," by W. Norris, illustrated; "Synthetica, being Meditations Epistemological and Ontological, comprising the Edinburgh Gifford Lectures of 1905," by Dr. S. S. Laurie, two vols.; "Plant Response," by Prof. J. C. Bose, C.I.E.; "Mathematical Papers of J. Willard Gibbs," two vols.; "Manual of Diseases of the Nose and its Accessory Cavities," by Dr. H. L. Lack; and "Philosophy of Religion," by Prof. G. T. Ladd, two vols.

Messrs. Sampson Low, Marston and Co., Ltd., will issue:—"Cotton Manufacture," by E. A. Posset, part ii., treating of combing, drawing, roller covering and fly frames, with an illustrated description of all the modern processes and machinery used, also all the calculations required.

Messrs. Macmillan and Co., Ltd., announce:—"Mediæval Rhodesia," by D. Randall-MacIver, illustrated; "The Philosophy of Religion," by Prof. H. Höffding, translated by Miss B. E. Meyer; "Electrical Engineering in Theory and Practice," by G. D. Aspinall Parr, illustrated; "Physical Optics," by Prof. R. W. Wood, illustrated; "A Manual of Geometry," by W. D. Eggar; "Lessons in Science, a Preliminary Course of Physics and Chemistry," by Prof. R. A. Gregory and A. T. Simmons; and a new edition of "Appendicitis: its Pathology and Surgery," by C. B. Lockwood.

Messrs. Methuen and Co. promise:—"Electrical Industry, Lighting, Traction, and Power," "Shipbuilding Industry, its History, Science, Practice, and Finance," "Money Market," "Business Side of Agriculture," "Brewing Industry," "Automobile Industry," "Mining and Mining Investments," "Civil Engineering," "Coal Industry," "Iron Trade," and "Cotton Industry and Trade."

Mr. John Murray announces:—"Heredity," by Prof. J. A. Thomson; "Researches in Sinai," by Prof. W. Flinders Petrie, F.R.S., illustrated; "Noteworthy Families (Science), an Index to Kinships in Near Degrees between Persons whose Achievements are Honourable, and have been Publicly Recorded," by Dr. F. Galton, F.R.S., and E. Schuster; "Our Waterways, a History of Inland Navigation considered as a Branch of Water Conservancy," by U. A. Forbes and W. H. R. Ashford; "Life of Isabella Bird (Mrs. Bishop)," by Miss A. M. Stoddart, illustrated; "The Dead Heart of Australia, a Journey around Lake Eyre in the Summer of 1901–1902, with an Account of the Lake Eyre Basin and the Flowing Well of Central Australia," by Prof. J. W. Gregory, F.R.S., illustrated; "Human Blood, an Introduction to the Normal and Pathological Morphology of Human Blood," eight lectures delivered in the Pathological Laboratory of the University of London, by Dr. G. A. Buckmaster, illustrated; "The Transition in Agriculture," by E. A. Pratt; "Recent Development in Biological Science," by W. B. Hardy, F.R.S.; "Artillery and Explosives, Essays and Lectures Written and Delivered at Various Times," by Sir A. Noble, K.C.B., F.R.S., illustrated; and "Chemistry of the Albumens," by Dr. O. B. Schryver.

The list of the Oxford University Press contains:—"Elementary Chemistry, Progressive Lesson in Experiment and Theory," by F. R. L. Wilson and G. W. Hedley, part ii.; Knuth's "Flower Pollination," authorised English translation by J R. A. Davis, vol. i.; Solereder's "Anatomical Characters of the Dicotyledonous Orders," authorised English translation by L. A. Boodle and F. E. Fritsch, revised by H. D. Scott; "A Catalogue of the Herbarium of Dillenius," by G. C. Druce, with the assistance of Prof. S. H. Vines, F.R.S.; "The Face of the Earth" ("Das Antlitz der Erde"), by Prof. E. Suess, translated by Dr. H. B. C. Sollas under the direction of Prof. W. J. Sollas, F.R.S., vol. ii., illustrated; "The Oxford Geographies," vol. ii., "The Preliminary Geography," by Dr. A. J. Herbertson, illustrated; "The Dawn of Modern Geography," by C. R. Beazley, vol. iii.; "Lectures on the Method of Science," edited by Dr. T. B. Strong; and a new edition of "Human Anatomy for Art Students," by Prof. A. Thomson, illustrated.

Messrs. G. Philip and Son, Ltd., have in the press:—"A Rhythmic Approach to Mathematics," by E. L. Somervell.

Sir Isaac Pitman and Sons, Ltd., announce:—"Mechanical Traction on Highways in the United Kingdom," by Dr. C. A. M. Barlow; and a new edition of "Home Gymnastics for Old and Young," by Dr. T. J. Hartelius, translated and adapted from the Swedish by C. Löfving, illustrated.

Messrs. G. P. Putnam's Sons promise:—"Jordan Valley and Petra," by Prof. W. Libbey and Dr. F. E. Hoskins, two vols., illustrated; and "Tibet and Turkestan," by O. T. Crosby, illustrated.

The Religious Tract Society announces:—"By-paths in Nature," by F. Stevens, illustrated; and "Every Boy's Book of British Natural History," by P. Westell.

The Sanitary Publishing Co., Ltd., announce:—"Smoky Fogs, How to Prevent," by A. J. Martin; "Drainage, Cast Iron House Drainage, with Especial Reference to the Drainage of Town Houses," by G. J. G. Jensen; and new editions of "Drainage, By-laws as to House Drainage and Sanitary Fittings made by the London County Council," annotated by G. J. Jensen, illustrated; and "Drainage, Modern Drainage Inspection and Sanitary Surveys," by G. J. G. Jensen, illustrated.

The Society for Promoting Christian Knowledge will publish:—"The Frozen South"; a volume on the Spectroscope, by Mr. H. F. Newall; and "The Properties of Liquids," by Prof. C. V. Boys, F.R.S.

Messrs. Swan Sonnenschein and Co., Ltd., promise:—"Physiological Psychology," by Prof. W. Wundt, translated by Prof. E. B. Titchener, in three vols., vol. ii., illustrated; "The History of Philosophy," by Dr. J. E. Erdmann, translated abridgment by W. S. Hough; "Thoughts and Things: a Genetic Study of Logical Process," by Prof. M. Baldwin, vol. i., "Theory of Knowledge, Functional Logic," vol. ii., "Theory of Reality, Real Logic"; "Man: or Problems Ancient and Modern relating to Man, with Guesses at Solutions," by Rev. W. T. Nicholson; "The Student's Text-book of

Zoology," by A. Sedgwick, F.R.S., vol. iii., completing the work, illustrated; "Insect Pests of the Farm and Garden," by F. M. Duncan, illustrated; and "School Gardening for Little Children," by L. R. Latter, with an introduction by Prof. Geddes.

The University Tutorial Press, Ltd., announce:—"Geometry, Theoretical and Practical," by W. P. Workman and A. G. Cracknell, part ii., part iii.; "Arithmetic for the Preliminary Certificate Examination," by H. R. Chope; "Model Answers to Arithmetic Questions for the Preliminary Certificate Examination"; "Algebra, Preliminary Certificate Edition, With Section on Graphs," by R. Deakin; "Geometry, Theoretical and Practical, Preliminary Certificate Edition (for Course A)," by W. P. Workman and A. G. Cracknell; "Euclid, Books i.–iii., Preliminary Certificate Edition, with Mensuration and Practical Problems arranged in Accordance with Euclid's Order of Proof," by R. Deakin; "Key to Matriculation Algebra"; "Logarithms and How to Use Them"; "Chemistry, First Stage, Theoretical Organic," by R. A. Lyster; "Chemistry, the Junior," by R. H. Adie; "Experimental Science, the Junior," by W. M. Hooton; "Hygiene, Certificate," by R. A. Lyster; "Technical Electricity," by Prof. H. T. Davidge and R. W. Hutchinson; "Physiology, First Stage," by Dr. G. M. Meachen; "Elementary Science of Common Life (Chemistry), Subject xxvi. of the Board of Education Science Examinations," by W. T. Boone; "Properties of Matter," by C. J. L. Wagstaff; "Elementary Science for the Preliminary Certificate Examination (General Section)," edited by Drs. R. W. Stewart and W. Briggs; "Elementary Science for the Preliminary Certificate Examination (Section A, Chemistry)," by H. W. Bausor; "Elementary Science for the Preliminary Certificate Examination (Section B, Physics)," by J. Satterly; "Intermediate Hydrostatics"; "Principles and Methods of Education," by Dr. S. S. Fletcher and J. Welton; and new editions of "First Stage Inorganic Chemistry (Theoretical)," by Dr. G. H. Bailey; "Synopsis of Matriculation Chemistry"; "New Matriculation Physics: Heat, Light, and Sound," by Dr. R. W. Stewart; "Light, Text-book of," by Dr. R. W. Stewart; and "Graphs, Graphical Representation of Algebraic Functions," by C. H. French and G. Osborn.

Mr. T. Fisher Unwin promises:—"Haeckel: his Life and Work," by W. Bölsche, translated by J. McCabe, illustrated; and "The Birds of Middlesex," by J. E. Harting, illustrated.

The following are Messrs. Whittaker and Co.'s announcements:—"A Pocket Book of Aëronautics," by H. W. L. Moedebeck, translated from the German by Dr. W. M. Varley; "Electricity in Mines," by P. R. Allen; "Steam Turbine Engineering," by T. Stevens and H. M. Hobart; "Electric Lamps and Electric Lighting," by L. Gaster; "Armature Construction, a Handbook for Electrical Designers," by H. M. Hobart; "Single-phase Commutator Motors," by F. Punga; "A Treatise on Coal Mining," by G. L. Kerr and D. Burns; "Polyphase Electric Currents," by A. Still; and "A Text-book of Botany," part i., "The Anatomy of Flowering Plants," by L. M. Yates.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The board of the faculty of natural science has approved the supplication of Mr. Walter Garstang, Lincoln College, for the degree of doctor of science.

Prof. W. J. Sollas and Dr. T. G. Bonney have been appointed examiners in the honour school of geology.

The grant of 250*l.* a year to the pathological laboratory from the University Chest has been renewed for five years, and additional grants of 100*l.* a year to the Pitt-Rivers Museum and to the Hope department of zoology, and 50*l.* a year to the departments of mineralogy and geology have been authorised by Convocation.

The important collection of New Zealand birds formerly belonging to the late Mr. S. William Silver has been presented to the museum by his widow.

A fellowship examination in chemistry has been announced by Merton College to begin on Tuesday, September 25. Candidates must have passed at the examinations required by the University for the degree of B.A. The value of the fellowship is 200*l.* a year for seven years, and the holder may be re-elected if he is duly qualified. Candidates may submit any dissertations or evidence of research work not later than September 20.

At a meeting of the Junior Scientific Club held on March 7, Mr. Henry Balfour read a paper on "The Natural History of the Bagpipe," and Mr. J. A. Brown one on "Electrons."

CAMBRIDGE.—The late Mr. Frederick James Quick having left his residuary estate to the University, the income to be used in promoting the study and research in the sciences of vegetable and animal biology, the council of the Senate has published a scheme for the administration of the fund. This has been approved by the trustees, to whom the will entrusts very considerable powers of emendation and alteration. It is proposed to establish a Quick professorship of biology with a salary of 1000*l.* a year, and with a sum not exceeding 300*l.* a year for the maintenance of a laboratory. In the first instance the professor is to devote himself to the study of the protozoa, especially such as cause disease. He will not be required to give lectures in more than one university term, when he will be expected to set forth the result of the researches carried on in his laboratory. By the terms of the will the professor must seek re-election every third year. The administration of the fund will rest with a board of managers, the members of which will also act as electors to the professorship.

The first report of the Studies and Examinations Syndicate with regard to the abolition of compulsory Greek having been rejected by the Senate, the Syndicate has tried again, and has issued a second report, in which it suggests what is known as a "bifurcation of studies." It is proposed that both in the honours and in the ordinary course for degrees the examinations shall be grouped into two sections, the literary and the scientific, and that while those who pursue the literary side must take in the Previous Examination two classical languages, those on the scientific side will be required "to take two languages other than English, one of the two being Latin or Greek." When the proposals come to be discussed a certain amount of opposition may be expected from the historians and moral science teachers, whose students are afforded no relief. Whether the masters of the situation, the non-resident members of the Senate, will allow the proposals to be accepted is doubtful. It is a well known fact that when the first report of the Syndicate was voted upon, a decided majority of the resident members of the University voted for reform. If the residents are again beaten they must put their trust in the Royal Commission which, from various signs, seems not so very far off.

The late master of Corpus Christi College, Dr. E. H. Perowne, has left his valuable collection of amber from the Norfolk coast to the University, to be deposited in the Sedgwick Geological Museum or in the Fitzwilliam Museum.

It is proposed to grant a sum of 75*l.* out of the works fund to Mr. W. G. Fearnsides, of Sidney Sussex College, towards defraying the expense of a visit which he proposes to make to Sweden to study the Tremadoc and Arenig beds.

The following have been appointed examiners in the special examination in geography and the examination for the diploma in geography:—Mr. G. G. Chisholm, Mr. A. R. Hinks, Mr. H. Y. Oldham, and Prof. W. W. Watts.

The next combined examination for sixty-six entrance scholarships and various exhibitions at Pembroke, Gonville and Caius, King's, Jesus, Christ's, St. John's, and Emmanuel Colleges will be held on Tuesday, December 4, and following days. Mathematics, classics, and natural sciences will be the subjects of examination at all these colleges. Scholarships and exhibitions will also be offered for history, for modern languages, and for Hebrew.

WE learn from *Science* that Mrs. A. A. Anderson has given 20,000*l.* to Barnard College, Columbia University, toward the establishment of a course in science.

THE fifth annual students' soirée of the Sir John Cass Technical Institute will be held on Saturday, March 17. The guests will be received by Sir Owen Roberts, chairman of the governing body, and Lady Roberts, Mr. George Baker, J.P., vice-chairman of the governing body, and Mrs. Baker. Short lectures and demonstrations on scientific subjects will be given during the evening.

AT the last meeting of the council of the University of Birmingham several appointments to the staff were made. Mr. George S. West was appointed assistant lecturer and demonstrator in botany in succession to Dr. A. J. Ewart; Dr. Theodore Groom was appointed senior lecturer in geology and geography to succeed Prof. W. W. Watts, F.R.S., recently appointed to the chair of geology in the Royal College of Science, London; and Mr. Donald M. Levy was appointed demonstrator in metallurgy to succeed Mr. H. N. Schnurmann. Communications were received announcing the bequest by the late Mr. John Feeney of the sum of 20,000*l.*, a donation from Messrs. W. and T. Avery, Ltd., of 500*l.*, and valuable gifts from Messrs. Veritys, Ltd., Mr. J. C. Vaudrey, and Mr. Willoughby Ellis. An assistant lectureship and demonstratorship in civil engineering was established.

FOR the last few years Oberlin College has been engaged, says *Science*, in raising a fund of 100,000*l.* This is now almost complete. The fund was started by an anonymous donor of Boston, who promised 20,000*l.* At the time of the trustees' meeting in November last the fund had reached 67,000*l.* Since then numerous gifts have been made, including 1000*l.* for library endowment, 400*l.* for additions to the women's gymnasium, 2000*l.* toward a men's building, 6600*l.* from the estate of Dr. C. N. Lyman, of Wadsworth, O., which will be devoted to library endowment, 15,000*l.* to be used as endowment for the Slavic department of the seminary, 2000*l.* for library endowment, and 1000*l.* for the art building. In the total of 97,000*l.* now raised is counted 25,000*l.* promised by Mr. Carnegie for a library, on condition that 20,000*l.* be raised for library endowment. To complete the fund, therefore, it will be necessary for the college to raise about 10,000*l.* more. It is expected that this will be done before commencement.

SOCIETIES AND ACADEMIES.

LONDON.

Chemical Society, March 1.—Mr. A. G. Vernon Harcourt, F.R.S., past president, in the chair.—Studies of dynamic isomerism, part iv., stereoisomeric halogen derivatives of camphor: T. M. **Lowry.** Measurements were given of the solubility in alcohol of α-chloro- and α-bromocamphors, αβ- and απ-dibromocamphors, and αβ- and απ-chlorobromocamphors, both alone and in presence of a small proportion of sodium ethoxide. The increase of solubility on addition of the alkali is ascribed to the formation in the solution of a small proportion of the stereoisomeric α′-compound.—The coagulating action of colloids, part i.: W. P. **Dreaper** and A. **Wilson.** The results obtained by the authors throw some light on dyeing and tanning processes. The influence of gallic acid in the manufacture of leather seems to be of a more direct nature than was previously supposed.—Studies on optically active carbimides, iii., the resolution of α-phenyl-α′-4-hydroxyphenylethane by means of *l*-menthylcarbimide: R. H. **Pickard** and W. O. **Littlebury.** The *l*-menthylcarbamates formed by combination with *l*-menthylcarbimide can be separated by fractional crystallisation, and are then hydrolysed by alcoholic sodium hydroxide.—Experiments on the synthesis of the terpenes, part viii., synthesis of the optically active modifications of Δ^3-*p*-menthenol(8) and $\Delta^{3:8(9)}$-*p*-menthadiene: F. W. **Kay** and W. H. **Perkin,** jun. Δ′-Tetrahydro-*p*-toluic acid, *l*-Δ^3-*p*-menthenol(8), $\Delta^{3:8(9)}$-*p*-menthadiene, and *d*-$\Delta^{3:8(9)}$-*p*-menthadiene have all been synthesised. By fractional crystallisation of the brucine and strychnine salts of the first-named compound it was resolved into optical isomerides, and from these the two other compounds were prepared in an optically active condition.—Studies in the acridine series, iii., the methylation of chrysaniline: A. E. **Dunstan** and J. T. **Hewitt.** —Note on the application of the electrolytic method to the estimation of arsenic in wall-papers, fabrics, &c.: T. E. **Thorpe.**—Nitrogen halides from camphoryl-ψ-carbamide: M. O. **Forster** and H. **Grossmann.** The action of potassium hypobromite and hypochlorite on camphoryl-ψ-carbamide has been found to give rise to dihalogen derivatives which have all the properties of compounds containing halogen attached to nitrogen.—The relation of position isomerism to optical activity, vi., the rotation of the menthyl esters of the isomeric chloronitrobenzoic acids: J. B. **Cohen** and H. P. **Armes.** In the present investigation the combined effect of the halogen and nitro-group on the activity of the menthyl group has been examined.

Mathematical Society, March 8.—Prof. W. Burnside, vice-president, and subsequently Sir W. D. Niven, vice-president, in the chair.—Sommerfeld's diffraction problem and reflection by a parabolic mirror: Prof. H. **Lamb.** Sommerfeld's problem is that of the diffraction of plane waves by a plane screen bounded by a straight edge. It is shown that Sommerfeld's solution may be arrived at in a simple way by combining certain simple particular solutions of the general equation of wave motion when expressed in terms of the coordinates that define two systems of confocal parabolic cylinders, the edge of the screen being the line of foci of the cylinders. Slightly modified forms of these solutions lead to a complete solution of the problem of reflection by a convex mirror in the form of a parabolic cylinder. It appears that in this application of the wave theory the reflected waves, which the ordinary processes of geometrical optics represent as diverging from a line of sources coinciding with the line of foci of the cylinder, really diverge from a plane of sources, terminated in an edge at this line, and extending thence with continually diminishing strength to an infinite distance on the concave side of the mirror. The problems of reflection by concave parabolic and paraboloidal mirrors are also discussed.—Function-sum theorems connected with the series $\sum_1^\infty x^n/n^2$: Prof. L. J. **Rogers.** The sums of the values of the function defined by the integral $\int_0 -(1-x)^{-1}\log x dx$ for various sets of values of the argument are shown to have definite constant values.—Investigations on series of zonal harmonics: Prof. T. J. I'A. **Bromwich.** The paper relates to the behaviour of series of the type $\Sigma a_n r^n P_n(\cos\theta)$ in the neighbourhood of points on the boundary of the region of convergence.—The functions $g_\beta(x,\theta)$ and $f_\beta(x,\theta)$ Rev. E. W. **Barnes.** The paper deals with the asymptotic expansions of special types of integral functions.—The relations between the *p*-line determinants formable from a *p* by *q* array: Prof. E. J. **Nanson.**—An informal communication On the divisors of numbers of certain forms was made by Lieut.-Colonel A. **Cunningham.** The special forms are $q2^q+1$ and $(a^{4x}+1)^3+1$.—Dr. F. S. **Macaulay** made an informal communication On the equilibrium of forces of given magnitudes the lines of action of which pass through given points.

PARIS.

Academy of Sciences, March 5.—M. H. Poincaré in the chair.—The suboxides of carbon: M. **Berthelot.**—Some arithmetical consequences of the theory of Abelian functions: G. **Humbert.**—The propagation of a movement round a centre in an elastic, homogeneous, and isotropic medium: study of the wave produced without change of density: J. **Boussinesq.**—The bean containing hydrocyanic acid, *Phaseolus lunatus*: L. **Guignard.** Frequent cases of poisoning of animals by this bean have occurred, due to the hydrocyanic acid it contains. This acid arises from a glucoside, phaseolunatine, which is present in the bean. Determinations of the amounts of hydrocyanic acid obtainable from beans from various sources gave figures varying between 0·006 per cent. and 0·102 per cent. A new method for detecting traces of hydrocyanic acid is given.—The synthesis of three dimethyl-cyclo-hexanols: Paul **Sabatier** and A. **Mailhe.** The method of Sabatier and Senderens has been applied to the addition of hydrogen to the three xylenols. Details of the preparation of these substances are given, together with their physical properties and those of their immediate derivatives.—The mag-

netic chart of the British Isles: B. **Baillaud** and E. **Mathias.**—Observations of the sun made at the Observatory of Lyons with the 16 cm. Brunner equatorial during the fourth quarter of 1905: J. **Guillaume.** Observations were possible on thirty-three days during the quarter. The results are given in three tables showing the number of spots, the distribution of the spots in latitude, and the distribution of the faculæ in latitude.—The deformation of quadrics: Luigi **Bianchi.**—The singularities of solutions to some partial differential equations of the elliptic type: Serge **Bernstein.**—The measurement of the loss of phase by reflection: A. **Perot.**—The phenomena of phosphorescence: A. **Debierne.**—Contribution to the study of selenious anhydride: Œchsner **de Coninck.**—The iodomercurates of calcium and strontium: A. **Duboin.** Crystallised compounds were isolated possessing the composition $CaI_2.HgI_2.8H_2O$ for the calcium salt, and $SrI_2.5HgI_2.8H_2O$ for the corresponding strontium salt.—The nature of the decomposition of an aqueous solution of copper sulphate by some alloys of aluminium: H. **Pecheux.** In a previous note these reactions have been studied from the qualitative side. The present paper is concerned with the quantitative aspect of the same reactions.—The estimation of cadmium: H. **Baubigny.**—The thermochemistry of the hydrazones and the osazones: Ph. **Landrieu.**—The condensation of benzidine-aniline, diphenyl-bidiazoaminobenzene, and diphenyl-disazoaminobenzene: Léo **Vignon.**—An antimony tartrate: J. **Bougault.** It is shown that the use of alcohol in the preparation of antimony tartrate leads to an impure product; similar objections do not apply to acetone.—The chemical study of the seeds known as Java peas: Émile **Kohn-Abrest.** Determinations of the amounts of hydrocyanic acid produced by various modes of treating the seeds.—The chemical characters of the wines arising from vines attacked by mildew: E. **Manceau.**—The evolution of the Eccrina of Glomeris: L. **Léger** and O. **Duboscq.**—A natural mollusc-bearing layer in the Macta, Algeria, and the effect of the nature of the flow of this river on the growth of the molluscs: J. **Bounhiol.**—The ferments of the placenta: MM. **Charrin** and **Goupil.**—The duration of persistence of the activity of the isolated heart: M. **Lambert.**—The influence of old age on the arterial pressure: A. **Moutier.**—A Miocene volcanic chain on the eastern border of the Limagne: Ph. **Glangeaud.**—The discovery of two Cretacean horizons in Morocco: W. **Kilian** and L. **Gentil.**—The grand cañon of Verdon, its age and formation: E. A. **Martel.**

DIARY OF SOCIETIES.

THURSDAY, MARCH 15.

ROYAL SOCIETY, at 4.30.—A Discussion of Atmospheric Electric Potential Results at Kew from Selected Days during the Seven Years 1898 to 1904: Dr. C. Chree, F.R.S.—On the Specific Heat of, Heat Flow from, and other Phenomena of the Working Fluid in the Cylinder of the Internal Combustion Engine: Dugald Clerk.

CHEMICAL SOCIETY, at 8.30.—The Interaction of well dried Mixtures of Hydrocarbons and Oxygen: W. A. Bone and G. W. Andrew.—The Explosive Combustion of Hydrocarbons: W. A. Bone and J. Drugman.—The Occurrence of Marsh Gas amongst the Decomposition Products of Certain Nitrogenous Bases as a Source of Error in the Determination of Nitrogen by the Absolute Method: P. Haas.—Studies on Comparative Cryoscopy. Part IV. The Hydrocarbons and their Halogen Derivatives in Phenol Solution: P. W. Robertson.—The Displacement of Acid Radicles. I. Displacement of the Chloride and Nitrate Radicles: A. F. Joseph.

ROYAL INSTITUTION, at 5.—The Physiology of Plants: Francis Darwin, For. Sec. R.S.

LINNEAN SOCIETY, at 8.—Discussion on the Origin of Gymnosperms: Opened by Prof. F. W. Oliver, F.R.S.

SOCIETY OF ARTS, at 4.30.—The Languages of India and the Linguistic Survey: Dr. George A. Grierson.

INSTITUTION OF MINING AND METALLURGY, at 8.—A Record of an Investigation of Earth Temperatures on the Witwatersrand Gold Fields, and their Relation to Deep Level Mining in the Locality: H. F. Marriott.—Note on the Ammonia-Copper-Cyanide Process: E. Le Gay Brereton.—The Cyanide Treatment of Cupriferous Tailings by the Sulphuric Acid Process: W. S. Brown.

FRIDAY, MARCH 16.

ROYAL INSTITUTION, at 9.—How to Improve Telephony: W. Duddell.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—*Continued Discussion*: Large Locomotive Boilers. G. J. Churchward.—*Probable Paper*: Petroleum Fuel in Locomotives on the Tehuantepec National Railroad of Mexico: L. Greaven.

EPIDEMIOLOGICAL SOCIETY, at 8.30.—Evolution in Relation to Disease: Dr. J. T. C. Nash.

SATURDAY, MARCH 17.

ROYAL INSTITUTION, at 3.—The Corpuscular Theory of Matter: Prof J. J. Thomson, F.R.S.

MONDAY, MARCH 19.

SOCIETY OF ARTS, at 8.—Fire, Fire Risks, and Fire Extinction: Prof Vivian B. Lewes.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The Economic Geography of Australia: Prof. J. W. Gregory, F.R.S.

VICTORIA INSTITUTE, at 4.30.—The Early Celtic Church of Britain and Ireland: Eleanor H. Hull.

TUESDAY, MARCH 20.

ROYAL INSTITUTION, at 5.—The Influence of Geology on Scenery: Dr. J. E. Marr, F.R.S.

ZOOLOGICAL SOCIETY, at 8.30.

ROYAL HORTICULTURAL SOCIETY, Scientific Committee, at 4.—Mendelian Laws of Inheritance: Charles C. Hurst.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Outer Barrier, Hodbarrow Iron Mines, Millom, Cumberland: H. Shelford Bidwell.

MINERALOGICAL SOCIETY.—On the Occurrence of Linarite and Caledonite in Co. Wicklow: Arthur Russell.

WEDNESDAY, MARCH 21.

SOCIETY OF ARTS, at 8.—Motor Boats: Bernard B. Redwood.

GEOLOGICAL SOCIETY, at 8.—The Chalk and Drift in Möen: Rev. Edwin Hill.—On the Relations of the Chalk and Boulder-clay near Royston (Hertfordshire): Prof. T. G. Bonney, F.R.S.—Brachiopod Homœomorphy: Pygope, Antinomia, Pygites: S. S. Buckman.

ENTOMOLOGICAL SOCIETY, at 8.

ROYAL MICROSCOPICAL SOCIETY, at 8.—A Contribution to our Knowledge of the Rotifera of South Africa: C. F. Rousselet.—On the Resolving Limits for the Telescope and the Microscope: E. M. Nelson.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—South Africa as seen by a Meteorologist: Dr. H. R. Mill.

THURSDAY, MARCH 22.

ROYAL SOCIETY, at 4.30.—*Bakerian Lecture*: Recent Advances in Seismology; Prof. J. Milne, F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Electrical Equipment of the Aberdare Collieries of the Powell Duffryn Co.: C. P. Sparks.—Electric Winding considered Practically and Commercially: W. C. Mountain.

ROYAL INSTITUTION, at 5.—Internal Combustion Engines: Prof. B. Hopkinson.

FRIDAY, MARCH 23.

ROYAL INSTITUTION, at 9.—Imperial Defence: Lord Roberts.

PHYSICAL SOCIETY (University College), at 5.—On Unilateral Electric Conductivity over Damp Surfaces: Prof. F. T. Trouton, F.R.S.—The Construction and Use of Oscillation Valves for Rectifying High Frequency Electric Currents: Prof. J. A. Fleming, F.R.S.—On the Use of the Cymometer for the Determination of Resonance Curves: G. B. Dyke.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Waves: F. K. Stevens.

SATURDAY, MARCH 24.

ROYAL INSTITUTION, at 3.—The Corpuscular Theory of Matter: Prof. J. J. Thomson, F.R.S.

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