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CONTENTS.

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Biological Terminology.

THE long-drawn-out discussion on biological terminology which has been a feature of the past year's numbers of NATURE has certainly supplied some food for thought. The state of Denmark may not be so rotten as Sir Archdall Reid believes, but no one who shares his enthusiasm for lucidity will maintain that biological terms are as crisp and unambiguous as could be wished. The reasons for vagueness are not far to seek. The first applies to all the sciences: that concepts change their content from age to age while the words remain the same. This applies to chemistry and physics, and even to mathematics; it must *a fortiori* apply to a young science like biology. Fresh facts demand that some alteration be made in the frames in which they have to be included—terms like 'organism,' 'development,' 'variation,' 'heredity.' The terms must remain, but their content requires continual readjustment. Sometimes, no doubt, new terms are needed, but the invention of good terms is a rare gift.

The second reason for biological vagueness is that biologists are not addicted to philosophy, using the word to mean a criticism of categories. Biologists are plain people dwelling in tents; they are not disciplined in methodology and the art of formulation. To many of them it has not occurred that there is any particular difficulty in terms like 'organism,' 'individual,' 'development,' 'differentiation,' 'evolution.' Some of them use the word 'development' in the forenoon and the word 'evolution' in the afternoon, meaning the same thing both times. Others use the term 'variation' in almost as many different senses as Herbert Spencer gave to the word 'force,' or the older economists gave to the word 'value.'

An outsider, reading Sir Archdall Reid's exposure of biology as 'morass,' 'a tumbling-ground for whimsies,' and so forth, may feel somewhat disturbed. Biologists are accused of playing with undefined terms like 'characters,' 'acquired,' 'inherited,' 'innate,' 'transmitted,' and the impression made on the innocent reader's mind is that biology is in a very unsatisfactory state. But things are not so bad as they seem. A term like 'acquired character' has entered the scientific dictionary as a technical term; it is not happy, but it is not ambiguous; every biologist who knows his business uses it in the same sense; it may be dropped—the sooner the better—but it cannot be re-defined; if we use it at all we must use it as Spencer and Weismann did, meaning a structural change in the body imprinted in the individual lifetime as the direct result of some new peculiarity in functional, nutritional, or environmental nurture, and taking such grip that it persists after the inducing conditions have ceased to operate. It may be advisable to drop the term 'acquired character' in favour of 'somatic modification,' or the like, but there is not in the mind of the competent biologist any confusion whatsoever in regard to what 'acquired character' means. He uses it as he might use a symbol 'A.C.'

It may be of use to try to state in outline the meaning which biologists attach to the terms they use in describing the facts of variation and heredity. When we compare a thousand descendants of two parents of known pedigree (we are evading the difficult question of 'species'), we may find that they are far from being all alike. They may differ from one another and from the norm of the stock to which they belong. These individual peculiarities can be measured and registered, and they might be called 'observed divergences,' 'observed differences,' 'new departures,' and so forth, so as to avoid any question-begging term. They are changes, at any rate, and many biologists apply to them the general word 'variations.'

When we begin to study the observed differences critically, we find that some of them are directly due to nurtural peculiarities. They are novelties due to novel conditions,—of use and disuse, or of food, or of surroundings. This individual has been imprisoned and that one has been overworked; this individual has been starved and that one overfed; this one has been brought up in a cave and that one exposed to the sun. The resulting differences are somatic modifications or acquired characters. They are exogenous, imprinted from without, what Weismann called 'somatogenic,' what might be called dints in colloquial biology. The goldfish kept three years in darkness loses the rods and cones of the retina; the tropical explorer becomes permanently tanned; the peach-trees taken to Reunion became evergreens, though it took some of them twenty years.

Every character is the *product* of hereditary 'factors' and a certain minimum nurture—food, oxygen, water, and a succession of liberating stimuli; but 'modifications' are lasting changes wrought on the body of the individual as the direct result of some peculiarity in the conditions of life. A modification is more than a response to liberating stimuli; it is an imprint, a dint, a parry to a nurtural thrust. The development of the head will only occur within certain limits—the primary conditions of viability; but the racial peculiarities of the skull are in a different category from deformations imprinted before or after birth. Sir Archdall Reid says this is a distinction without a difference. But we think he is making fun of us.

Of course none of these distinctions is absolutely hard and fast, for we are dealing with the complexity of life. Thus it is not easy to draw a firm line between temporary *adjustments* like sunburning, and lasting *modifications* like tanning. On the other side, there are great differences in the degree in which the developmental expression of hereditary 'factors' demands particular nurtural conditions. Up to a certain point the development of the lung of the embryo chick proceeds without functioning—the gramophone of the inheritance continuing to unwind after the spring has been released. But beyond a certain point the actualisation of the hereditary lung 'factors' will not go *unless the chick breathes*. For a short time an embryo rabbit will go on developing outside the mother; which shows that the environmental dependence is not so narrowly limited as one might think. On the other hand, there are several well-known mutations in the fruit-fly Drosophila which never find expression unless there is some particular external condition, such as humidity. As the next generation shows, the primordium of the character is part of the inheritance, but it remains latent or unexpressed.

Now when we add up all the peculiarities that can be reasonably interpreted as modifications and subtract them from the total of observed differences, we get a remainder—variations as opposed to modifications; or, if the term variations has been already used more widely, *germinal variations* as opposed to Lamarck's *"changements acquis."* They occur among individuals *living under the same nurtural conditions*. They arise from within, endogenously, centrifugally; they are 'blastogenic' in Weismann's phraseology; they are expressions of new permutations and combinations among the germinal 'factors,' 'genes,' or 'determinants'; they may be expressions of changes in the constitution of a 'gene' itself. We know very little as to the origin of these germinal variations *sensu stricto*, but there is no confusion in our concept. Then we may proceed further to distinguish quantitative gametogenic fluctuations from qualitative gametogenic mutations, meaning by the former a little more of this and a little less of that (a longer feather, a higher crest), meaning by the latter a discontinuous or transilient variation, such as a laciniate condition in the Greater Celandine leaves or hornlessness of calves in a horned race. But in the present state of ignorance the categories of variation are necessarily very debatable.

The scheme runs thus :—

OBSERVED DIVERGENCES	GAMETOGENIC VARIATIONS	FLUCTUATIONS
		MUTATIONS
	SOMATIC MODIFICATIONS	

What terms are used does not seem urgently important; there has often to be a long struggle for existence among terms. What is important is that biologists understand one another, and, in spite of Sir Archdall Reid, we protest that they do. One expert may say, "I prefer to use the term fluctuations not for slight intergrading variations, but for certain kinds of modifications"; another may say: "What you diagnose as 'fluctuating *variations*' are really 'fluctuating *modifications*,' though I confess I cannot put my finger on the peculiarity in nurture that induces them." Both may be right; both may be wrong; but there is not in either of them any confusion of thought. Prof. MacBride finds evidence of the transmission of acquired evergreenness in peach-trees; we think that the results may have been due to antenatal infection with certain metabolites, for the seed sojourns for a long time in intimate union with the parent. This is a question of interpretation; there is no confusion of thought in regard to the meaning of 'acquired character.'

In his year of letters Sir Archdall Reid discovered so many mares' nests that we cannot get rid of the suspicion that he has been laughing up his sleeve all the time. Since the scientific study of heredity began, with Darwin let us say, it has been clear that words like 'inherit' and 'transmit' are metaphorical, but has any biologist been misled? Heredity, after all, is but a convenient term for the genetic relation between successive generations,—a relation in which the persistence of a specific organisation is secured through the continuity of the germ-plasm, and yet not so rigidly secured as to shut out the possibility of new germinal variations. Except colloquially, the antithesis is not between heredity and variation, but between complete hereditary resemblance and divergence. The inheritance is all that the living matter of the fertilised egg-cell includes in virtue of its strictly hereditary relation. It would not in the strict sense include either a symbiotic alga or an antagonistic microbe.

The vehicles of the specific organisation are 'factors,' 'genes,' 'determinants,' many of which are certainly located in the chromosomes of the nuclei, but there are also extra-nuclear vehicles, *e.g.* organ-forming substances in the cytoplasm. What the genes precisely are remains uncertain; they are the germinal representatives or initiatives of subsequent differentiations; in a few cases already it seems possible to say that a particular gene, *e.g.* one affecting eye-colour in so-and-so, lies about the middle of the third chromosome! A character in the fully-formed organism is usually the expression of several genes, and the same gene may affect several characters. Every biologist agrees with Sir Archdall Reid that the inheritance is made up of factors for characters, not of the characters themselves, for a character is the *product* of nature and nurture. But just as Darwin sometimes spoke, for short, of an adaptation as the result of selection, when he meant, of course, selection acting on successive crops of heritable variations, so it seems unnecessarily purist to insist always on speaking of hereditary factors rather than of hereditary characters. Gerould has shown that conspicuous blue-green caterpillars (of *Colias philodice*) may arise as mutations in a pure race of inconspicuous grass-green caterpillars, and the offspring of the adults into which two blue-greens develop will breed true. But what is inherited is not the coloration of the blood, for that is due to the xanthophyll and chlorophyll of the food-plant. What is inherited is some subtle gene (a nuclear enzyme perhaps) which acts as a decoloriser or inhibitor of the xanthophyll. Yet would it not be a trifle pedantic to insist that the blue-green character is non-heritable.

Whether the specific organisation which persists in the germ-cell lineage can be added to in a definite way by nurtural changes or modifications wrought in the body of the parent, remains a question for legitimate discussion (see, for instance, Mr. Cunningham's interesting "Hormones and Heredity"), but it is not playing the game to say that "there is absolutely no meaning in the neo-Darwinian statement that acquired characters are not transmissible." Some biologists find convincing evidence that a novel somatic modification can affect the germinal organisation in a manner so specific that the offspring show some representation of the acquired character. Others remain unconvinced by any of the evidence that has been as yet adduced. What is wanted is not a rumpus about terminology, but more facts, and more critical interpretation.

Sir Archdall Reid complains that biologists are thirled to a particular classification of characters into 'innate' and 'acquired,' whereas they ought to take a leaf from the physiologist's book. But this is simply another of the windmills at which the Quixotic knight tilts. When thinking along a particular line biologists must distinguish characters as expressions of an intactly persistent germinal organisation, or as expressions of germinal rearrangements—shufflings of the factorial cards, or as dints directly due to peculiarities in nurture, and this does not exhaust the classification *sub specie hereditatis*. But at another time, the biologist is just as open as any physiologist to classifications of characters from other points of view. Are they generic, specific, or varietal; are they adaptive or non-adaptive; are they the outcome of natural selection, or of sexual selection, or of neither; are they exhibited at birth or do they appear in the course of later development (like the curlew's bill); are they activated by hormones or by more general constitutional changes; are they progressive or involutionary, do they illustrate differentiation or de-differentiation? There is no restricted outlook in the biologist's classification of characters.

Sir Archdall Reid expostulates with biologists for writing down to the 'nature' account what should be put to the 'nurture' account, but the biologists agree with him in *not* keeping two accounts. The mistake of making an antithesis between 'nature' and 'nurture'—two components of one resultant—is not one to which a biologist can plead guilty. But the biologist understands the difference between hereditary nature realising itself in its normal nurture, and hereditary nature being indented by novel peculiarities. It need not be a 'glaring' nurtural peculiarity, as Sir Archdall Reid says,—a minimal change, *e.g.* in salinity, may serve. It must not be supposed, however, that it is easy to distinguish, especially in mammals and seed-plants, between what are antenatal modifications and what are normal expressions of the inheritance. Much is congenital that is not hereditary. If we only knew the wan newt Proteus in the dark waters of the Dalmatian caves, we should surely conclude that the power of producing pigment was not in its inheritance. Yet we should be wrong. The power of producing pigment has not been lost; it expresses itself whenever the Proteus is exposed to the liberating stimulus of light. Similarly, as to various 'specific characters' of animals, *e.g.* parasites, which we know only from one environment, it may be that some of them are purely modificational, like the green of the Colias caterpillars, and imprinted on each successive generation. Further knowledge may show that many characters which we now regard as 'innate' are only 'imprints' on an innate susceptibility or receptivity. But our inability to say 'yea' or 'nay' in regard to such questions is due to our ignorance, not to any confusion of thought.

No doubt Sir Archdall Reid has made many true statements, *e.g.* that, to begin with, the organism and the inheritance are one and the same; that the inheritance consists of potentialities or factors, not of characters; that a specific character is always the product of 'nature' and 'nurture,' which are complementary, not antithetic; that it is not always easy in practice to distinguish the hereditarily inborn from an antenatal modification; that functioning often counts for much in development. But with these statements all competent biologists are in agreement. To a large extent Sir Archdall Reid has indulged in bogey-hunting and in the pastime of re-editing the scientific dictionary and then importing fallacies into biological argument. To accuse biologists of not dealing with realities is as absurd as indicating that Lamarck's first law is not sense. When a man pulls his bow so tightly as all that, he hits nothing.

Elements and Isotopes.

Isotopes. By Dr. F. W. Aston. Pp. viii+152. (London: E. Arnold and Co., 1922.) 9*s.* net.

DR. ASTON'S book on "Isotopes" is very far from being a mere reprint of his published papers; it constitutes a masterly review of all the aspects of the subject with which he deals. As a result, those who are already familiar with the principal papers which have appeared in the *Philosophical Magazine* will find in the book much that is both interesting and instructive. Thus, the author's account of Dempster's alternative form of the mass-spectograph is particularly interesting; and Dr. Aston has rendered a real service to readers who are not specialists by bringing together in one volume all the methods and results of work on isotopes. His summary of the investigations which have been carried out on radioactive isotopes is particularly concise and readable.

The discovery of isotopes, and particularly of isotopes which are not radioactive, has brought into prominence the necessity for considering afresh the definition of an element. In practice two methods have been adopted. In the radioactive series each isotope has been regarded as a separate element, and has been given a separate name and a separate symbol; this practice has arisen naturally in view of the fact that the isotopes, although having the same atomic number, differ not only in their atomic weight, but also in the source from which they are prepared, and in their stability as measured for instance by the half-life period. On the other hand, it is equally in accordance with traditional methods that chlorine, which has been described as an element ever since the appearance of Davy's celebrated Memoir in 1810, should still be treated as an element in spite of the fact that it is now known to contain two isotopes, the atoms of which differ from one another by two units of atomic weight. This alternative view is supported by Dr. Aston, who recommends that all atoms having the same atomic number should be regarded as isotopes of one element, the number of elements being thus limited to 92. Having regard to the fact that inactive isotopes (with the exception of lead) occur in nature in constant proportions, and that the alteration of these proportions is a matter of very great difficulty, it is unlikely that any complications would arise amongst practical chemists if chlorine and bromine were still to be described as elements instead of as mixtures of elements. It is, however, clear that the two alternative usages which have been described above cannot both persist, and that we must either adopt some common symbol and name for each group of radioactive isotopes, *e.g.* for the three radioactive emanations, or adopt some distinguishing symbol and name for each of the constituent isotopes of chlorine or bromine, *e.g.* as Dr. Aston has suggested, Cl^{35}, Cl^{37}, Br^{79}, Br^{81}, etc.

This subject was discussed at the recent meeting of the Solvay Institute in Brussels, and the latter alternative appeared to find favour among the majority of the chemists who were present. In this connexion it is of interest to notice that the last occasion on which it became necessary to reconsider the traditional definition of an element arose from the promulgation of Dalton's atomic theory. In his "New System of Chemical Philosophy" (Part I., p. 143) published in 1808, Dalton puts forward the conclusion that "the ultimate particles of all homogeneous bodies are perfectly alike in weight, figure, etc." If this statement be applied to the nucleus atom of Rutherford, it would appear that the atoms of a homogeneous element must be alike both in weight and in the configuration of the protons and electrons of which the atom is composed. Modern investigations have shown that it is possible to find, on one hand, isotopes composed of atoms which possess a like configuration of the planetary electrons in the outer domain of the atoms, but which differ in the weight of the nucleus; on the other hand, isobares are known (*e.g.* Ne^{40} and Ca^{40}) the atoms of which are alike in weight but differ in configuration. It is of course possible that, in the future, atoms may be discovered which are alike both in weight and in the configuration of their planetary electrons, but differ in their radioactive properties as the result of a different arrangement of the protons and electrons in the nucleus, giving rise to a sort of nuclear isomerism. One such case has been suspected amongst radioactive elements; but Prof. Piccard, of Brussels, has suggested that this assumption need not be made if the actinium series of radioactive bodies be assumed to have its origin in an isotope of uranium, instead of in the element which gives rise to the radium series.

On this hypothesis *odd* atomic weights may be assigned to the radio-elements of the actinium series, while retaining *even* atomic weights for those of the radium and thorium series; under these conditions isotopic members of the actinium and radium series would always differ in atomic weight and the occurrence of isobaric isotopes would be impossible. Prof. Piccard states that this conclusion is supported by recent measurements made to test the application to actinium of the Geiger-Nuttall relationship between the penetrating power of the rays and the life of the atoms emitting them. There is therefore at the present time no valid objection in regarding as the criterion of a homogeneous element the fact that its atoms must be alike both in "weight" and in "figure" (as indicated by identical atomic weights and atomic numbers) and using this as a basis in constructing a working definition of the element.

Elementary Pure Mathematics.

(1) *An Introduction to Projective Geometry.* By Prof. L. N. G. Filon. Third edition. Pp. viii + 253. (London: Edward Arnold and Co., n.d.) 7*s.* 6*d.*

(2) *Elementary Analysis.* By Prof. C. M. Jessop. Pp. viii + 175. (Cambridge: At the University Press, 1921.) 6*s.* 6*d.* net.

(3) *The School Algebra (Matriculation Edition).* By A. G. Cracknell. Sixth impression (second edition). Pp. viii + 456 + lxviii. (London: W. B. Clive: University Tutorial Press, Ltd., 1921.) 6*s.* 6*d.*

(4) *A First Book in Algebra.* By Dr. F. Durell and E. E. Arnold. Pp. v + 339 + xli. (New York and Chicago: C. E. Merrill Co., n.d.) n.p.

(5) *A Second Book in Algebra.* By Dr. F. Durell and E. E. Arnold. Pp. v + 330 + xliii. (New York and Chicago: C. E. Merrill Co., n.d.) n.p.

(6) *Plane and Solid Geometry.* By Dr. F. Durell and E. E. Arnold. Pp. 503. (New York and Chicago: C. E. Merrill Co., n.d.) n.p.

(7) *Plane Geometry: Practical and Theoretical, Pari Passu.* By V. Le Neve Foster. (Bell's Mathematical Series for Schools and Colleges.) Vol. 1. Pp. xi + 229 + xi. Vol. 2. Pp. xii + 230-423 + xi. (London: G. Bell and Sons, Ltd., 1921.) 3*s.* each.

(8) *Plane Geometry for Schools.* By T. A. Beckett and F. E. Robinson. Part 1. Pp. viii + 239 + v. (London: Rivingtons, 1921.) 5*s.*

(9) *Wightman's Secondary School Mathematical Tables.* Edited by F. Sandon. Pp. 96. (London: Wightman and Co., Ltd., 1921.) 6*d.*

(1) THE fact that a third edition has been issued of Prof. Filon's book on projective geometry is a sufficient indication of its usefulness and merit. There is little to record as regards changes or innovations. One would only like to say that while from chapter 2 onwards the book reads fairly plainly, the first chapter is not at all easy reading. Why need the student be frightened off by such an introduction to a subject full of fascination? If a further edition is called for, perhaps the author could see his way to simplify this chapter and improving the illustrations so as to make it more palatable.

(2) A text-book should avoid two extremes: the tendency, on one hand, to include all possible cases that are likely to arise, and all kinds of questions that an examiner is likely to set; and the danger, on the other hand, of presenting the subject-matter of the book in the form of an almost "bald and uncon-

vincing narrative." Prof. Jessop's "Elementary Analysis" is so short that on occasion it seems to err in the direction of the second extreme. Yet it is a very clear and useful account of what the average student needs to know if he is to benefit by further work, where the calculus and the methods of analytical geometry are required. University courses continue to become more and more inclusive, and many students will be grateful to the author for the brief presentation he offers them. The straight line and circle are discussed in about fifty pages, differential and integral calculus occupy about a hundred, and about twenty pages are devoted to the general equation of the second degree and the properties of the ellipse, parabola, and hyperbola. The last chapter is almost tabloid in character.

(3) This, like the other publications of the University Tutorial Press, seems to be just the book required for "learning up" for an examination. Nothing, apparently, is left to chance, and the student who has mastered its contents should be able to defy any examiner to do his worst. On reading this book one feels inclined to exclaim: Did I know all this when I passed the matriculation examination? For a class text-book a shorter book with more emphasis on principles and less on the examination spectre would be preferable: but for private students—and they are more numerous than many suppose—this book has its obvious advantages. In the second edition chapters have been added on indices and logarithms.

(4) and (5) Elementary mathematics is gradually being released from the burden of manipulative skill and the bogey of the examiner. Students are no longer expected to do jig-saw puzzles with mosaics of simple, square, and double brackets, with pluses and minuses peppered about like the charges in the modern chemist's atom. This release is well symbolised in Messrs. Durell and Arnold's two books on algebra, written for American schools. Each book represents a year's course, developed with skill and knowledge of pedagogical methods. In the first book each chapter is divided into two parts, the first for the beginner in his first half-year, the second for revision during the second half-year. It is doubtful, however, whether revision by complete repetition is an ideal educational process. The second book is in two parts, the second being "a reservoir of extra work for bright pupils." The complete course is very suitable for the standard of matriculation.

(6) Messrs. Durell and Arnold's "Geometry" contains a full and competent account of all the pure geometry that is required by pupils of higher schools. The sequence is reasonable, and the treatment is practical although the book is essentially a course on formal geometry.

The subject-matter comprises the usual plane geometry and a rather extensive course on solid geometry. The sphere is dealt with in some detail, and an interesting feature of the book is the brief account of the properties of spherical triangles as regards congruence and area. This is a very desirable innovation that English books might copy with advantage. Spherical figures are of importance in many branches of knowledge and the student must somehow pick up a little knowledge about them: but, like hydrostatics, spherical trigonometry is a step-child of the modern mathematical teacher.

As the authors use algebraic symbols, it would have been an advantage to introduce numerical trigonometrical methods. The historical sketches are rather dull.

(7) Books on practical geometry usually give constructions for a number of geometrical exercises with little justification, if any. Books on formal geometry aim at giving a systematic and logical course on the subject: occasionally a lapse into real life takes place, but the main object is to build up a structure of reasoning based on a few fundamental notions and postulates. Where the theoretical and practical are combined, one usually has the two more or less dissociated. Mr. Foster's idea is to combine the advantages of both the practical and the formal by working them into an organic whole; he tries to inculcate the geometry of the class-room by means of the observation of outdoor and home life. He has achieved considerable success. The separate formal propositions are reduced to a very small number—and this is an advantage. In the two parts already issued the ordinary plane geometry is covered, up to and including proportionality and similar figures. A third part is promised on solid geometry.

(8) Like Mr. Foster, Messrs. Beckett and Robinson make it their aim to combine deductive with practical geometry. They commence with a number of practical constructions without proofs, even such complicated problems as the drawing of common tangents to two unequal circles. The student is then introduced to notions of area and to solid figures, thus completing the preliminary section. Section I. gives the formal geometry of triangles and parallelograms, with exercises from life, mechanics, and physics. In Section II. are given the properties of circles in formal order, while Section III. deals with areas and Pythagoras's theorem. Cartesian co-ordinates are introduced, contours explained, and a brief course on numerical trigonometry completes the first part. It will be interesting to see the second part. Pythagoras's theorem is too late in the book: the student usually feels quite excited about this theorem, and the sooner he gets excited about

geometry, the better. The gradient is too steep in the trigonometrical portion.

(9) Why does Mr. Sandon use the title "Mathematical Tables"? In reality the booklet seems to be intended as a pocket cyclopædia of much, if not all, knowledge. In 96 small pages we get treatises on arithmetic, algebra, mechanics, calculus—gamma functions are also included—astronomy, insurance, geology, philology, chemistry, earthquakes, the Morse code, the size of wall-paper, ship watches and bells, and Suffolk and Essex measures of butter and cheese, to name only a selection. The book may be useful, but the mathematical portions are hopelessly marred by misprints.

S. BRODETSKY.

Miscellanea Physica.

(1) *La Loi de Newton est la Loi Unique: théorie mécanique de l'Univers.* Par Max Franck. Pp. iv+158. (Paris: Gauthier-Villars et Cie, 1921.) 12 fr. 50.

(2) *Fluoreszenz und Phosphoreszenz im Lichte der neueren Atomtheorie.* Von P. Pringsheim. Pp. viii+202. (Berlin: J. Springer, 1921.) England, 144 marks; Germany, 48 marks.

(3) *La Physique théorique nouvelle.* Par Dr. J. Pacotte. Pp. viii+182. (Paris: Gauthier-Villars et Cie, 1921.) 12 fr. net.

(4) *Mécanismes communs aux phénomènes disparates.* Par Prof. M. Petrovitch. (Nouvelle Collection Scientifique.) Pp. v+279. (Paris: Félix Alcan, 1921.) 8 fr. net.

(5) *Über Äther und Uräther.* Von P. Lenard. Pp. 56. (Leipzig: S. Hirzel, 1921.) 9 marks.

(6) *Physikalische Rundblicke. Gesammelte Reden und Aufsätze.* Von Max Planck. Pp. iv+168. (Leipzig: S. Hirzel, 1922.) 60 marks.

(7) *Physique élémentaire et théories modernes.* Par J. Villey. Première Partie, Molécules et Atomes: États d'équilibre et mouvements de la matière (Mécanique, Statique des fluides, Chaleur, Élasticité et Acoustique). Pp. x+197. (Paris: Gauthier-Villars et Cie, 1921.) 15 fr.

(1) THE following are the first and the last statements in M. Franck's "loi unique." "Tout volume est composée d'une somme de positif qui est son potentiel et de négatif qui est sa masse. . . . Ces variations de potentiel dans l'éther sont elles-mêmes déterminés directement ou indirectement par l'Esprit." This law "nous supposons capable de tout expliquer"—everything, from the origin of the universe, through Boyle's law, to the constitution of electricity. Such books are the despair of the reviewer. If they are frankly denounced as nonsense, a cry is raised about an obscurantist hierarchy impervious to all new ideas; while a careful analysis of them with a view of discovering whether anything valuable is concealed in the tangled mass of verbiage requires an enormous expenditure of time and labour. We announce therefore that we have not read M. Franck's book, and do not intend to read any book which aims at subverting the foundations of physics unless the author tells us, in terms of its language and concepts, exactly in what respect he finds its conclusions unsatisfactory.

(2) At the other extreme in this miscellany is Dr. Pringsheim's monograph. It is a summary of all important work on phosphorescence and fluorescence between 1908 (the date of the summary in Kayser's Spectroscopy) and March 1921, the experiments being interpreted so far as possible according to Lenard's theory modified and expanded in accordance with that of Bohr. The author's name is a sufficient guarantee of excellence, and it is unnecessary to say more than that the work is worthy of his reputation and of the traditions of German book-production. The book has a special and melancholy interest in that it is the product of the author's internment for five years in Australia, whither he had gone to attend the British Association meeting as a guest of the Australian Government. He is naturally bitter about his treatment, and every one must agree that the incident was exceptionally unfortunate; but alas! war is a succession of unfortunate incidents.

(3) Intermediate between these extremes is M. Pacotte's volume, which is "un essai historique, critique et méthodologique" on the new physics. M. Borel in his preface suggests that nobody has the right to criticise an attempt to compress so much matter within 200 pages who is not prepared to perform the task better himself; and we accept his suggestion in so far as we shall make no attempt to discuss whether, in his capacity as historian, M. Pacotte has always traced the true line of development. But criticism and "methodology" imply a point of view, and it is open to any one to suggest that the point of view is mistaken, without falling under M. Borel's ban; for if the point of view is wrong the book is not worth writing. We have no intention of declaring categorically that it is wrong, for science may be viewed from many standpoints, all of which are equally legitimate. But we think it right to indicate that M. Pacotte's standpoint is not that of the average physicist, nor yet that of the average philosopher; both of them will experience some difficulty in understanding what exactly is the task that M. Pacotte is trying to perform. His standpoint is perhaps more nearly that of the mathematician; but if the book is addressed to mathematicians it is surely a defect

and not a merit that it should be wholly free from mathematical symbolism. However, it is clear that M. Pacotte has read and thought deeply, and if we have to confess that the results of his labours are not very helpful to us, we are most ready to admit that they may be very helpful to others.

(4) Prof. Petrovitch here pursues the suggestive train of thought which he has started in earlier works. He begins with the familiar observation that physical metaphors are used in connection with the most diverse events; thus we speak of the *cooling* of enthusiasm or the *oscillation* of public opinion. Such metaphors indicate that the most diverse phenomena follow tendencies (*allures*) characterisic of mechanics. He seeks accordingly to classify these tendencies into a few well-marked groups and to place all phenomena of all kinds whatsoever within these groups according to the nature of their tendencies. These ideas (of which the briefest outline must suffice here) lead naturally to a scrutiny of the whole range of knowledge; M. Petrovitch's knowledge is wide and, so far as we can test it, accurate; yet he carries it easily. Accordingly his book will appeal to many who are not immediately interested in his epistemological theses.

We are inclined to think, however, that he overrates the importance of the resemblances he studies. Thus he maintains that when he has analysed any phenomenon according to its tendencies and displayed its mechanical analogies, he has explained the phenomenon in the sense used by Kelvin when he said that to explain a phenomenon was to construct a mechanical model of it. Such a doctrine we think might lead to the most dangerous fallacies if applied to psychology and politics; and though M. Petrovitch, confining himself to analysis and not to construction, seems always to stop short of the precipice, he approaches it very nearly and might well lead shallow thinkers over it.

(5) Prof. Lenard has republished in pamphlet form an article which appeared in Stark's "Jahrbuch." It is one more attempt to avoid the principle of relativity and quantum theory, and seems, as usual, to forget that it is impossible to avoid them entirely, because, since they are formal theories in accord with experiment, any other physical theory so in accord must be formally in accord with them. The basic idea of Prof. Lenard's theory is that every body has its private ether, disturbances in a private ether being transferred in some way (undefined) to a primary ether (Uräther) for transmission to a great distance. To those so attached to ethers that the idea is attractive of an infinite number of coincident ethers all moving at any point with different velocities, the idea will probably appeal. But we confess that we see no need for the Uräther; so far as we can see, private ethers would suffice, together with the assumption that each observer can only perceive disturbances set up in his private ether. (Cf. *Phil. Mag.* 19. 189. 1910.)

(6) Prof. Planck publishes here a collection of his semi-popular lectures and essays, partly on radiation and quantum theory, partly on scientific principles. All that he says here will, of course, be familiar already to serious students, while for the general reader books in a foreign tongue are seldom useful. No comment therefore seems necessary; to praise Prof. Planck's work would be impertinent.

(7) Finally, we come to M. Villey's very interesting volume, of which the first part only is published as yet. Its intention is "A ceux qui possèdent déjà les connaissances normalement enseignées dans les traités de physique élémentaire, exposer les mêmes matières sous une forme assez renouvelée pour stimuler leur curiosité et élargir leurs points de vue" and "A ceux qui veulent acquérir ces connaissances en mettant à profit leur loisir, les présenter non sous l'aspect du manuel pédagogique, mais sous une forme plus attrayante et de lecture plus facile." It is the second object which appeals more directly to us and, we think, to the author. It is impossible for a professional physicist to decide definitely how far the aim has been achieved; we must "try it on the dog"; but we are certain that if the author has failed, his task is impossible and that the fault lies not with him but with the audience he is addressing. The book is a model of that simple, lucid, and logical exposition of which the French language—or at least the French people—alone seems capable. Every one, however deeply versed in physics, will find in it something to stimulate his interest and imagination. M. Villey deserves the thanks of all who desire a wider diffusion of scientific knowledge; we hope that an English translation will soon appear—if only somebody can be found with the courage and ability to undertake it.

N. R. C.

Strasburger's Text-book of Botany.

Strasburger's Text-book of Botany. Rewritten by Dr. H. Fitting, Dr. L. Jost, Dr. H. Schenck, Dr. G. Karsten. Fifth English Edition Revised with the Fourteenth German Edition by Prof. W. H. Lang. Pp. xi+799. (London: Macmillan and Co., Ltd., 1921.) 31*s*. 6*d*. net.

THE last English edition of this well-known text-book was published in 1912, and the appearance of the present volume will be welcomed by the large number of students and teachers who are already familiar with its many excellent features. This edition appears under a new title, as "Strasburger's Text-book of Botany," to commemorate the original founder of the work. The general plan of the book remains the same. The first part, entitled "General Botany," includes morphology and physiology; the second part, "Special Botany," is also in two divisions, the first dealing with Thallophyta, Bryophyta, and Pteridophyta, and the second with the Spermatophyta.

The division on morphology, which is contributed by Prof. Fitting, has been entirely rearranged and largely rewritten. It now begins with a consideration of the cell, tissues and tissue systems, and then under the heading of "Organography" deals with the external form and internal structure of the members of the plant. This arrangement permits of a logical development of the subject, in which some consideration is given to form in relation to function. It is clear, however, that the subjects included in this divison cannot be adequately treated in the 206 pages devoted to it. Such subjects, for example, as leaf fall, structure of the hypocotyl, and the phylogeny of the vascular system, receive very scanty treatment.

In a new section six pages are devoted to the theory of descent and the origin of new species. It is doubtful whether such a condensed account of this subject will be of value to the student even for examination purposes. It is true that, as in other sections of the book, there are references to the more important publications on this subject, but since both here and in the sub-section of physiology dealing with heredity and variability the references are almost exclusively to German authors, these will be of limited use to the English student.

The section on physiology, by Prof. Jost, is on the same general lines as that in the fourth edition. It has, however, been very carefully revised and brought up to date, and provides an excellent survey of the subject.

In the Cryptogamic section, for which Prof. Schenck is responsible, the most recent additions to the subject have been brought under review. Among the Thallophytes, alternation of generations is described and figured in the Laminariaceæ, and Kniep's work on the Hymenomycetes is included. The treatment of the vascular cryptogams has been much improved by the insertion of the more important fossil forms in their natural positions among the existing families.

The work as a whole presents a comprehensive and accurate account of the subject. Its main defect is that, in including so much within the limits of a single volume, the treatment of the various sections has suffered from undue compression. The book was written for German students and it cannot fully satisfy the requirements of English teachers, since it does not give prominence to those aspects of the subject with which the English School of botanists has been identified. Nevertheless, it has already established itself as a standard text-book, and in its present revised form and at its extremely moderate price it will meet the needs of many different types of student.

R. J. T.

German Monographs on Biochemistry.

Die Biochemie in Einzeldarstellungen. Herausgegeben von Dr. A. Kanitz.

(1) *Temperatur und Lebensvorgänge.* Von Dr. A. Kanitz. Pp. x+175. 54 marks.

(2) *Über künstliche Ernährung und Vitamine.* Von Prof. Dr. F. Röhmann. Pp. vi+150+2 plates. 42 marks.

(3) *Über partielle Eiweisshydrolyse.* Von Prof. Dr. M. Siegfried. Pp. iv+64. 15 marks.

(4) *Die Einwirkung von Mikroorganismen auf die Eiweisskörper.* Von Dr. P. Hirsch. Pp. x+256. 63 marks.

(Berlin: Gebrüder Borntraeger, 1915–1918.)

THE present may be emphatically termed the period of Monographs of Science. The vast accumulation of facts has long passed the bounds prescribed by the general treatises on physics or chemistry, in which it was formerly possible to find a readable and critical treatment of the subject as a whole. These were succeeded by encyclopædic dictionaries, of the type of Beilstein, which, however useful and indeed invaluable for reference, make no claim to be readable or even critical. In all branches of science, however, the demand is insistent for a comparatively brief and comprehensive account of the present state of knowledge, and it is to meet this that the various series of sectional monographs have sprung up. Among the first of these were the admirable monographs on biochemistry edited by Hopkins and Plimmer from 1908 onwards, and in the series now under review we have the German equivalent of these. Originated as late as 1915, comparatively few volumes have as yet been issued, but the promised list of publications indicates, both by the subjects proposed and the distinction of the authors, that they will form a valuable addition to the biochemist's bookshelf.

(1) The effect of temperature on life processes is here discussed in great detail. After a general introduction in which the physical chemistry of the subject is considered the characteristic optimum effect produced in living organisms is fully analysed. A special part follows in which a summary of the literature is made and the data are incorporated in tables, each class of phenomenon, such as the heart-beat, the action of

poisons, the duration of life, etc., being separately discussed. This provides a very valuable compendium of the existing information on the subject. Among the most remarkable results recorded are the enormous values of the temperature coefficient (Q_{10} = 1000–4000) in many cases of the duration of life, especially among invertebrates. In this connection the suggestive fact must be borne in mind that high values of Q_{10} are also characteristic of the denaturation of proteins and the inactivation of enzymes. These high values are the more remarkable as in the majority of cases physiological phenomena fall into line with ordinary chemical reactions, the rate of which is increased 2 or 3 times by a temperature rise of 10° C., although in many cases the coefficient falls with increasing temperature.

(2) Criticism, especially of the fundamental propositions enunciated in a new and rapidly expanding branch of knowledge, is useful because it prompts the investigator to re-examine the experimental foundations on which he has based his conclusions. In this way Dr. Röhmann's work has doubtless done good service, but the theses which he maintains, that accessory food factors or vitamins have no existence in fact and that "deficiency" diseases such as beriberi and scurvy are due to prolonged and one-sided feeding with "imperfect" proteins, can no longer be seriously maintained. The author's experimental material has already been very carefully analysed and criticised by Osborne and Mendel, who have pointed out in what directions the "purified" diets of Röhmann fell short of the standard which is now known to be required.

Since the date of publication of this book (1916) overwhelming evidence has been produced—largely in this country and America—that Hopkins was fully justified in his original conception of accessory food factors which cannot be synthesised by the animal but are necessary for the proper utilisation of its diet, however complete this may be in the fat, carbohydrate, protein and salts which form its main constituents. Röhmann has turned his face back towards the ideas of the older physiologists and his book remains as a monument beside the path by which the newer doctrine has been reached.

(3) The hydrolysis of proteins by enzymes is a highly complex process, the exact course of which is by no means fully understood. In the present work a full account is given only of the later stages of this decomposition, commencing with the peptones and proceeding downwards through the kyrines to the peptides. The term peptone is often used vaguely to designate various mixtures of the hydrolysis products of protein, often including the albumoses. We are here given an excellent account of the work, largely due to the author, by which the peptones, in the narrower sense, have been isolated from the products not precipitated by ammonium sulphate, and have been characterised by their chemical and physical properties. Their composition varies with their origin but is always relatively simple, although the author hints at the existence of modes of union between their constituents other than the characteristic peptide linkings to which so much importance has been attached in the structure of the proteins.

(4) The physiological importance of many of the bases formed by the action of bacteria on the amino-acids has made them of great interest to the biochemist. English readers have already at hand, in Prof. Barger's monograph on "The Simpler Natural Bases," a work which includes a great part of the matter dealt with by Dr. Hirsch. In the present volume the subject is approached from the point of view of bacterial action and a full account of the products which have been recognised is given. In addition to descriptive matter, practical methods are also included and a considerable amount of attention is given to the physiological properties of the substances concerned. Interesting sections treat of the pathological effects of bacterial products derived from the proteins and of their therapeutic application.

The author also includes a short but suggestive chapter on the relation between these products and various substances of a basic character which occur in animal and vegetable organisms. There is little doubt that many of the latter have been formed from amino-acids by reactions similar to those produced by micro-organisms, if not actually by their active intervention. A copious bibliography is appended to the work.

ARTHUR HARDEN.

Our Bookshelf.

Alumni Cantabrigienses: A Biographical List of all known Students, Graduates, and Holders of Office at the University of Cambridge, from the Earliest Times to 1900. By Dr. J. Venn and J. A. Venn. Part I., *From the Earliest Times to 1751.* Vol. 1, *Abbas-Cutts.* Pp. xxviii+437. (Cambridge: At the University Press, 1922.) 150s. net.

THE President of Gonville and Caius College and his son have undertaken an immense task in the preparation of the volumes, the first of which is under notice. Dr. Venn has by previous work on the archives of his own College prepared himself for this investigation, and it is as much due to him as to the wise rules of Dr. Caius that the Caius records of past members can be described as "much the best of the series." There are 76,000 names dealt with up to the date 1751 covered by Part I., and details have been gathered together from many sources. For instance, John Ward of

Cambridge is shown by an Institution Book to have been appointed a rector in 1673; a visitation of 1677 states that he was ordained priest at Norwich in 1672; the Bishop's Register there states that this ordinand was B.A. of Jesus College; by this he can be safely identified, and the Jesus books give his parentage and birthplace.

Naturally not many details can be given even when available of most of the persons named in the book. The great majority entered the Church; and the Reformation, the Commonwealth, and the Restoration figure largely in the doings of the Cambridge graduates. But other professions are represented, such as physicians and lawyers, and more rarely statesmen and diplomats. Occasionally careers ended in the stake, the block, or in simple outlawry. Amongst names in the present volume that will interest men of science are William Croone, in memory of whom was founded the Croonian lecture; Isaac Barrow, "famous as a mathematician, as Greek and Latin scholar, and above all as a theologian"; Peter Barwicke, Censor of the R.C.P., one of the few doctors who worked through the Plague of London; Licius Bomelius, physician, astrologer, and magician to the Czar, who died in prison; and Henry Cavendish, chemist, physicist, and mathematician, who left a fortune of more than a million. It is greatly to be hoped that Part I. of this work will receive sufficient support to enable Part II. (1752–1900) to be published.

Catalogue of 1068 "Intermediate" Stars situated between 51° and 65° South Declination for the Equinox 1900: From Observations made at the Sydney Observatory, New South Wales, Australia, during the Years 1918–1919, under the Direction of Prof. W. Ernest Cooke. Pp. vii+29. (Sydney: W. A. Gullick, 1921.)

SOMEWHAT novel lines have been adopted in this catalogue. Prof. W. E. Cooke has endeavoured to follow literally the resolutions of the Paris Astrographic Congress of 1909, which divided the stars to be observed into three classes—Fundamental, Intermediate, and Reference—the second class being deduced from the first by differential methods, and in turn serving as standards for the third class, which are to be used to give co-ordinates on the Astrographic Plates. The position of the Fundamental stars in the zone were taken from the Cape Catalogue, 1900, using the proper motions given there. The new Catalogue reproduces their assumed places with mean discordances of $0{\cdot}001^s$ and $0{\cdot}02''$. The probable error of a catalogued position is found to be $\pm 0{\cdot}006^s \sec \delta$, and $\pm 0{\cdot}13''$.

Collimation errors and errors of division are determined in the ordinary way, but all other corrections, including the instrumental ones and those due to clock error, precession, nutation, and aberration, are applied by differential formulæ described in Mon. Not. R.A.S., vol. 79, No. 1. It is claimed that this method facilitates the correction of the catalogue places for any changes in the adopted places of the Fundamental stars. The pivot errors of the circle are given, but have not been applied, as the method of reduction should eliminate them. The transits were observed by the travelling-wire method, except for some faint stars which were observed over fixed wires. A constant correction was applied to these to reduce them to the other system.

A. C. D. C.

The Serbian Epidemics of Typhus and Relapsing Fever in 1915: Their Origin, Course, and Preventive Measures employed for their Arrest. (An Ætiological and Preventive Study based on Records of British Military Sanitary Mission to Serbia, 1915.) By Col. William Hunter. (Reprinted from the Proceedings of the Royal Society of Medicine, 1919, vol. xiii.) (Section of Epidemiology and State Medicine.) Pp. 29-158. (London: John Bale, Sons, and Danielsson, Ltd., 1920.) 7*s*. 6*d*. net.

IN this account of the Serbian epidemics of typhus and relapsing fever in 1915, Col. William Hunter makes a very interesting and valuable contribution to the medical literature of the war.

The R.A.M.C. Mission arrived in Serbia at the worst period of an uncontrolled epidemic of lice-borne diseases. Its principal task was not the supply of extra clinical assistance, but the arrest of the epidemic by administrative and sanitary measures. The chief of these measures were the temporary cessation of railway traffic, the suspension of leave from the army, and the introduction of a widely applicable method of disinfection. The author demonstrates clearly the striking effect on the epidemic of both the cessation and the resumption of the movements of people.

By numerous charts and tables a large number of statistics of considerable scientific interest is recorded, and this, with the details given of the sanitary and preventive measures adopted, will be of value to all connected with the prevention of lice-borne and water-borne diseases in dealing with any future outbreaks on the Continent or elsewhere.

Benign Stupors: A Study of a New Manic-Depressive Reaction Type. By Dr. A. Hoch. Pp. xii+284. (Cambridge: At the University Press, 1921.) 14*s*. net.

AUGUST HOCH recognised the confusion arising out of the classification of certain functional psychoses as Manic-Depressive Insanity; he therefore set out to show that the elation and depression (from which the name has been derived) are of no more theoretical importance than other moods which characterise the group. The volume before us, edited by Dr. J. MacCurdy after the death of Hoch, is designed to show that the symptom-complex associated with apathy is as distinct as that of mania, and the book introduces the functional psychoses characterised by benign stupor.

The essentials of the stupor reaction are (1) more or less marked interference with activity; (2) interference with the intellectual processes; (3) affectlessness; (4) negativism. These and other symptoms which make up the clinical picture of the benign stupor are discussed in great detail and illustrated by numerous cases. Of particular interest is the peculiarity of the ideational content in its preoccupation with the theme of death, often to the complete exclusion of all other ideas.

A brief chapter is devoted to treatment, and stress is laid on the importance of stimulating the patient to exert as much effort as possible. The book is one of the most valuable contributions of recent years to psychiatric literature, and its editor is to be congratulated on the success with which he has carried out the task laid upon him.

Nerve Exhaustion. By Sir Maurice Craig. Pp. 148. (London: J. and A. Churchill, 1922.) 6*s.*

IN introducing the subject of nerve exhaustion, Sir Maurice Craig makes it evident that he is writing for the general practitioner rather than for the student of psychology. He particularly emphasises the importance of the prevention of nerve exhaustion, which is defined as "a state in which there is undue physical, nervous, or mental fatigue." The author considers that the essential factor leading to such a state is "hypersensitivity," which may be physical or psychical, and the recognition of which may enable one to prevent the onset of nerve exhaustion.

It follows from the definition that the condition has a very wide etiology and symptomatology, each of which is discussed under numerous headings. A separate chapter is devoted to sleeplessness and to the individual hypnotics which are used in the treatment of insomnia, but there is no mention of bromural, which is a safe and efficient sedative for most of the milder cases.

In the last chapter it is urged that the treatment of mental disorder should be freed from the legal restrictions which hamper it—restrictions which may have been necessary many years ago, but are now obsolete. The author considers that there are numerous cases of functional nervous disorder which should be allowed institutional treatment without the necessity of being certified, and he instances strong evidence in support of this.

The book will be of considerable value to the practitioner in the recognition and treatment of minor functional nervous disorders.

Guide to the Reptiles and Batrachians exhibited in the Department of Zoology of the British Museum (Natural History), Cromwell Road, London, S.W.7. Third edition. Pp. 56. (London: British Museum (Natural History), 1922.) 1*s.*

THIS publication is intended more for the general public than for the student of zoology. The author, whose name does not appear, has obtained a good balance in the treatment of the different groups of animals with which the little book deals. Exception must be taken to the statement that the Opisthoglypha, or back-fanged snakes, are, although poisonous, not dangerous. This is not always the case: the South African boomslang, *Dispholidus typus*, for instance, having in recent years been proved to be an extremely dangerous snake, there being more than one record of its bite having caused death in man. Experimentally it has been shown that the boomslang is more venomous than the cobra, puff adder, or any other justly dreaded South African snake.

Excellent in so many respects, it is a pity that so little pains have been taken in the correction of the proofs, some of the sentences, owing to lack of punctuation, being almost incomprehensible. This little guide, which is profusely illustrated by photographs of specimens in the museum, and by illustrations reproduced from the Cambridge Natural History, is, however, well worth the shilling asked for it.

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.*]

The Rat and its Repression.

I HAVE read with great interest the very able and exhaustive article by Mr. Alfred E. Moore in NATURE of May 20, p. 659, on the rat and its repression. As I have taken great interest in the question of rat suppression, I should like to add a few words to what Mr. Moore says.

If the campaign against these vermin were in such hands as his we should go a long way towards exterminating them, but the public does not take sufficient interest in a matter which they always think affects other people more than themselves. The result is that where one man makes a raid against his rats, twenty do nothing to suppress them, and perhaps ten others actually encourage their propagation by the carelessness with which they leave food and consumable stores unprotected.

One could have hoped that the Ministry of Agriculture would have taken up the matter seriously. The amount of damage done to food-stuffs is incalculable. Not only do rats raid our storehouses, but they also attack the crops almost before they are sprouting in the ground. Those who know Norfolk and Suffolk and any grain-growing district are familiar with the squeals of rats nesting in the hedgerows as they go along the roads, and when the seed-corn has been planted fields are covered with well-worn rat tracks, from which these rodents start to grub up the seeds from the ground and devour them. In December and January every field is covered with rat scratchings, which means that so much corn has been devoured. The loss to the farmer is very great and, of course, the public participates in this.

Piecemeal suppression is of little use, as rats are great travellers, but if a sufficient effort were made by the Ministry of Agriculture to stir up local authorities and to provide some funds, which would not amount to very much, to help them, we should have a remarkable result in the clearing from our fields and our food stores of these destructive vermin. The Treasury will sanction millions for unproductive expenditure. Any minister can get practically what he wants for his own particular hobby, but in this matter of real usefulness where capable local administration is at hand, our custodians of the public purse refuse to assist in any way.

Individual philanthropists cannot be expected to find money for a public cause when the representatives of the public stand idly by. What remedy have we for this? Only one; which is that we should put pressure locally upon our parliamentary representatives and send up communications to the Ministry of Agriculture, urging upon them the necessity of some sort of action.

I hope this advice will not fall upon barren ground. There are plenty of men in both Houses of Parliament who will be very glad to help in pushing this agitation forward.

ABERCONWAY.

43 Belgrave Square,
London, S.W., May 24.

The Blue Flame produced by Common Salt on a Coal Fire.

THE blue flame produced by sprinkling salt on a glowing coal fire is a good example of common knowledge, which, not finding a niche and an explanation in text-books, becomes a recurrent topic of inquiry and discussion in scientific journals. It may perhaps be of interest if I add a historical note to what Prof. Merton has stated in NATURE of May 27, p. 683.

The blue flame in question appears to have been first treated from the spectroscopic standpoint by the late Dr. J. H. Gladstone in 1862 in a letter to the *Philosophical Magazine* (ser. iv., vol. 24, p. 417). Without being quite conclusive he seems to have regarded copper chloride as the source. The matter was raised again by an anonymous letter to NATURE in 1876 (vol. xiii. p. 287), and a discussion has recurred from time to time in these columns from that date until 1890. Full references to this are to be found in Kayser's "Handbuch der Spectroscopie," vol. v. p. 391. A communication to NATURE by T. N. Müller in 1876 (vol. xiii. p. 448) seems to have hit the mark. He recognised the flame as being like that of copper chloride, and, surmising that the source of the copper lay probably in the pyrites of the coal, found that the blue flame did not appear when salt was sprinkled on a glowing fire of charcoal. The matter was clinched by Salet in 1890 (*Comptes rend.* 110, p. 282), who identified the spectrum with that of copper chloride as carefully mapped by Lecoq de Boisbaudran, and he actually isolated metallic copper from the fuel ash.

The blue flame given by salt always seems to me distinguishable from that of carbon monoxide, and appears very bright by contrast with the yellow-red glow of the fire. It is somewhat surprising to see how far the yellow sodium flame is suppressed.

ARTHUR SMITHELLS.

The University, Leeds, May 28.

Optical Resolving Power and Definition.

IN NATURE of May 27, p. 678, Mr. A. Mallock suggests as a quantitative measure of "definition" in an optical instrument "the angular or linear size of the field of view compared with the smallest corresponding quantity which can be clearly distinguished," and proceeds to extend "definition" on an equivalent general basis to a number of other instruments.

Whether or not this proposal will serve a useful purpose in other directions need not be discussed here, but in the case of optical instruments the measure proposed will not commend itself to opticians, for it involves a radical change in the accepted meaning of "definition" in this connection. The suggestion in fact amounts to nothing more than the measurement of the angular field of view in terms of a unit which varies with the aperture of the lens and the wave-length of the light which is used, a proposal which surely carries its own condemnation in its enunciation. That the ratio in question is worthless as a measure of "definition" is obvious from the consideration that in many instruments, at say the centre of the field, the resolving power and the "definition"—that is the degree to which details of an object are clearly discernible in its image—may remain unaffected while the field of view is greatly changed by an alteration in the size of a suitably placed stop. Conversely in apparently similar instruments the "definition" may vary appreciably from one instrument to another while the field of view and the resolving power are alike in all cases.

The distinction between resolving power and definition is real but not easily defined in a few words. The former deals with the discernment of separate sources of such apparent minuteness that it cannot be claimed that the image indicates with any accuracy the shape of the source itself. The latter is concerned with the sharpness of the apparent image outline of larger objects. The former depends primarily on the dimensions of the first dark ring in the image of an apparently point source, and the conditions of observation require the range of wave-lengths of light forming the focussed image to be limited. The latter depends more upon the broad light distribution in the diffraction pattern than upon the alternations of light and darkness, and the range of wave-lengths is not an important factor. As the size of the rings is not greatly affected by small amounts of aberration, the resolving power is not a suitable measure of the correction of a lens system, but it is precisely upon the degree to which aberrations are removed that definition depends. Of two photographic lenses with the same resolving power, and the same field of view, one may give brilliant pictures because the definition is good and the other comparatively flat pictures because the definition is poor. To the user of simple instruments definition is of great importance, resolving power does not concern him.

This is not a suitable occasion on which to discuss the measurement of "definition" or the standards which are suitable for application to various types of instrument. The subject is one of great difficulty particularly in view of our ignorance of the extent to which it is possible to eliminate aberrations in systems of simple construction. Lest, however, readers of NATURE should be misled it cannot be too emphatically stated that in omitting from "definition" its most essential factor and substituting therefor an independent conception, Mr. Mallock's attempted generalisation is likely to prove only a cause of confusion to those who hope to measure the merits of optical instruments by its means.

T. SMITH.

The Difference between Series Spectra of Isotopes.

PROF. P. ZEEMAN mentioned to me recently some new measurements of the absorption spectrum of lithium which he undertook in order to prove the presence of both isotopes. It seems to me, that at the present time it is not certain what one should expect here theoretically. Bohr's formula for the change in the frequency ν due to the motion of the nucleus has been applied by him only to the cases in which a *single electron* moves around the nucleus; namely, to H and He^+. Recently the formula has been also applied by various authors (see F. W. Aston, "Isotopes," p. 123—London 1922) to the calculation of the difference between series spectra of isotopes; this means to atoms in which *several electrons* move around the nucleus. So far as I know there are as yet no investigations on the equation which must for these cases replace Bohr's equation

$$\nu_2 : \nu_1 = \frac{M_2}{M_2 + m} : \frac{M_1}{M_1 + m} \quad . \quad . \quad . \quad (1)$$

(M_1, M_2, m are respectively the masses of the nucleii of the isotopes and of the electron; ν_1, ν_2 are the frequencies of corresponding lines).

In the case of one electron only, (1) follows immediately from the well-known transformation of the "problem of two bodies" from absolute to relative co-ordinates (see, *e.g.*, Whittaker, "Analytical

Dynamics," § 46). For several electrons there is no similar simple transformation. The "radiating" electron compels the remaining electrons to execute motions of reaction, which also influence the nucleus.

Probably it will be possible to derive a sufficiently approximate formula for the case of the p- and d-motions of lithium. This must be very difficult, however, for the case of the 1·5 S-path. The fact that at all events equation (1) cannot be true in general for atoms with several electrons will be shown by the following example (though of course on account of the Principle of Correspondence not representing a process really occurring in nature): two electrons move around the nucleus in a centrally symmetrical configuration, at first in a two-quantum and then in a one-quantum circle. By symmetry the nucleus remains continually at rest. In this case therefore the liberated energy and, consequently, the radiated ν would, contrary to (1), be exactly independent of the mass of the nucleus.

P. EHRENFEST.

The University,
Leyden, Holland.

I SHOULD like to add a few remarks to the interesting letter of Prof. Ehrenfest about the contents of which he was so kind to inform me before publication. As pointed out in his letter, the effect of the mass of the nucleus on the spectrum of an atom, containing more than one electron, is a complex problem which depends on the electronic arrangement in the states of the atom, involved in the emission of the lines, in a way which has hitherto not received sufficient attention. Not only may the mass effect disappear completely in such cases, where several electrons move round the nucleus in equivalent orbits, but, as indicated by Prof. Ehrenfest, this effect may also in case of the motions which we actually meet in the emission of the series spectra be different from that calculated for an atom with one electron.

Although in the emission of these spectra we are concerned with motions whereby a single electron moves in an orbit different in type from the orbits of the other electrons, the problem differs essentially from the problem of two bodies in celestial mechanics. Thus according to the picture of atomic constitution, outlined by the writer in two letters to NATURE (March 24, 1921, October 13, 1921), we shall assume that the electron connected with the emission of the series spectra, although during the larger part of the revolution it remains outside the configuration of the electrons in inner groups, it will nevertheless in certain states penetrate into the interior of the atom during its revolution. The fact that the electron in the inner loop of its orbit is subject to large forces is of preponderant influence as regards the fixation of the energy in the corresponding stationary states of the atom. For such a motion the effect of the nuclear mass might differ essentially from that estimated from an examination of the mechanical properties of the motion in the outer loop only, and the question arises, whether the mass effect is sufficiently large to account for the discrepancies, observed by Merton, in the wave-lengths of certain lines in the spectra of lead isotopes, which although very small are yet much larger than those to be expected from the simple formula quoted in Prof. Ehrenfest's letter.

Although this question seems difficult to settle without a closer investigation, it would scarcely appear probable that the answer will be affirmative. On the other hand, it cannot be excluded that the discrepancies in question are due to a slight difference in the field of force surrounding the nucleus, arising from the difference in the internal nuclear structure of the lead isotopes. This possibility has been discussed from various sides. At first sight we meet with the difficulty, that the dimensions of the nucleus (*ca.* 3×10^{-12} cm.), estimated from experiments on the scattering of α-particles, are exceedingly small in comparison with the dimensions of the orbits of the electron responsible for the emission of the series spectra, which are of the order 10^{-8} cm. or larger.

This difficulty may disappear, however, by considering the circumstance mentioned above, that in certain states the series electron during a short interval of its revolution penetrates deeply into the interior of the atom. In fact, we must assume, that this electron in the states corresponding to the S-terms of the series spectra penetrates to even smaller distances from the nucleus than the electrons in the innermost group of the atom, the dimensions of which are in lead smaller than 10^{-10} cm. To the possible importance of this point in connection with the spectra of isotopes my attention was kindly directed by Dr. Kramers in a discussion about Prof. Ehrenfest's letter.

N. BOHR.

University, Copenhagen.

The Destruction of Mosquito Larvæ in Salt or Brackish Water.

A NUMBER of experiments on the destruction of mosquito larvæ by the well-known system of "surface oiling," carried out at Hayling Island during the year 1921, supplied further evidence of the fact that this method is not one of universal application. The production of an unbroken film of a sufficiently lasting nature is sometimes an impossible task, notably in cases where the water surface is broken up by growths of reeds, etc., or is too freely exposed to the wind. In cases of this kind it is necessary to discard the oil film in favour of a "larvicide," that is to say, a substance which, by mixing with the infested water, will destroy the larvæ.

Unfortunately, however, practical information concerning larvicides is difficult to obtain. In the literature of the subject references are to be found to a number of suggested substances, but the vast majority of these stand self-condemned owing to the prohibitive cost that would be entailed by employing them in the prescribed "strengths" on any practical scale. A large number of these larvicides are, moreover, admittedly ineffective when added to brackish or salt water, and are consequently of little value in districts such as Hayling, where the salt-water mosquito, *Ochlerotatus detritus*, is the principal offender.

A number of tests have recently been carried out in the laboratory of the Hayling Mosquito Control, in the hope of discovering a larvicide which could be used successfully (and at a low cost) in salt, or partly salt, water. It was found that a liquid containing 15 per cent of soluble cresol, sold as a disinfectant under various names, gave very promising results in the laboratory. This liquid, at a dilution of 1 in 16,000, was found to kill the larvæ of *Ochlerotatus detritus* in one hour; at a dilution of 1 in 32,000, in one and a half hours; and at a dilution of 1 in 48,000, in three and a half hours. In the majority of these experiments the water containing the larvæ was of a salinity about half that of sea water.

In order to test this larvicide on a larger scale, a shallow stretch of brackish water adjoining the Hayling Golf Links was selected for experiment. This water was very heavily infested with the larvæ of *Ochlerotatus detritus*, together with a large number of pupæ. Titration experiments carried out by Mr. Lyon Turner showed that the salinity of the water was 49 per cent. that of pure sea water.

After estimating the volume of the water as 20,000 gallons, it was decided to use the larvicide in the proportion of 1 in 16,000, the quantity required being therefore 1·25 gallons. The result of the experiment was entirely satisfactory, a thorough examination on the following day failing to detect a single live larva or pupa. Further examinations were made with the same result on April 26 and May 2, and on May 5 the success of the experiment was further confirmed by an examination made by Mr. P. G. Shute (Ministry of Health Laboratory).

Two other ponds badly infested with the larvæ of *Ochlerotatus detritus*, and containing a large number of pupæ, have since been treated with like success, a thorough examination of both ponds being made on the following day without a single live larva or pupa being found.

It was noticed during the experiments that the addition of the larvicide to one of the ponds in which the water was only slightly saline, produced the characteristic "milkiness" associated with the use of disinfectants of this class. In treating the other ponds where the water was of greater salinity, this cloudy appearance was not produced, although the results obtained in all the three experiments were equally successful. A series of laboratory tests showed that the "milkiness" occurred whenever the proportion of sea water to fresh water was less than 1 in 7, the cloudy appearance being uniformly distributed through the water treated. When the larvicide was added to water of greater salinity, it diffused in the form of minute globules. It was suggested by Mr. P. G. Shute that, in cases where the proportion of sea water exceeded one-seventh, the milkiness (and the accompanying uniform diffusion of the larvicide) might possibly still be produced if the larvicide were diluted with a small quantity of *fresh* water before use. Experiment showed this to be the case, and this preliminary dilution is obviously to be recommended whenever the larvicide in question is to be added to water of appreciable salinity.

It is probable that successful results will be obtained with even smaller proportions of the larvicide than those employed up to the present, since the effects produced with dilution of 1 in 48,000 indicate that the limit has been by no means reached. Further experiments in this direction are now in progress.

It is important to note that water treated with this larvicide in the proportions mentioned is quite harmless to human beings or animals drinking it accidentally.

The comparative cost of "larviciding" and "paraffining" in any given case depends, of course, upon the depth of water to be treated. In cases where the water is shallow there is little to choose as regards expense, even when the larvicide is used in as large a proportion as 1 in 16,000. If d be the depth of any particular sheet of water in inches, n the "dilution" (or the number of parts of water which can be treated by one part of the larvicide), and c the ratio of the cost of the larvicide to that of paraffin, then the ratio of the expense of "larviciding" to that of "paraffining" has been shown by Marshall (*Science Progress*, January 1922, p. 468) to be given by the expression

$$(1500 \times c \times d)/n.$$

In the case of the first pond referred to above, d was 3 inches and n was 16,000. The price of the fluid was 5*s*. 9*d*. a gallon, so that c may be taken as 4. Hence the relative cost of the operation, compared to paraffining, was

$$(1500 \times 4 \times 3)/16,000, \text{ or } 1{\cdot}125,$$

the actual cost of treating the 1420 square yards of pond being about seven shillings. It should be noted, moreover, that as the water surface in this case was much exposed to wind, paraffining carried out on previous occasions had proved quite ineffective.

Since a cubic yard is the space occupied by 168 gallons, it will be found that the number of gallons in any piece of water is $(A \times d)14/3$, where A is the surface area in square yards and d is the depth in inches. So that, if the larvicide is to be used in the proportion of 1 in n, the number of gallons required will be $14/3(A \times d)/n$ gallons. This is a useful formula for calculation, particularly when a definite value of n has been decided upon for treating a number of ponds.

JOHN F. MARSHALL.

Seacourt, Hayling Island, Hants.

The Teaching of Natural History in Schools.

IN an article which appeared in NATURE, May 13, p. 628, dealing with the memorandum of a British Association Committee on this subject, the following statement occurred: "It devolves on the teachers of zoology to show in detail the kind of zoological syllabus that can be put into operation in schools as a basis for zoological teaching." May I be allowed, as one whose privilege it has been to teach zoology to some hundreds of boys, to offer one or two suggestions for such a syllabus?

The writer of the article was entirely favourable to the spirit of the memorandum, as indeed are a great number of persons responsible for the direction of education. With regard to the younger generation, the learners, the question is answered with no uncertain voice. I have put the choice of zoology or botany to forms of boys of all ages from 14 to 18, and have found invariably that 90 per cent. or more vote for the teaching of zoology. It may be that the boys scent my personal leaning towards zoology (though I try to be impartial) or, again, that they regard the study of animals as a more masculine pursuit than the study of plants. At the same time, it is evident that the boy's mind shows a genuine thirst for a knowledge of animal life.

There are two aspects of the application of zoology to the school curriculum. On one hand, there are the older boys who are being trained for some definite profession—medicine, agriculture, biological research, and so forth. On the other, there are large numbers of younger boys, very few of whom will ever require zoology as a professional subject, who are being taught biology as part of their general education. Zoological syllabuses for the professional examinations are issued by the various universities; moreover, in the Higher Certificate Examination zoology may be offered as a group subject. Thus, in the case of senior boys the biology master has ample guidance in the general requirements of a zoological education, and can develop and extend his teaching accordingly; but in teaching zoology to younger boys the master has to evolve his own syllabus and to form his own standard of attainment. It is with the latter aspect of the subject that I propose to deal.

The boy of fourteen when he comes to the study of biology requires something more substantial than what is generally implied by "nature study." He is perfectly capable of appreciating the elementary conceptions of anatomy and physiology. He is, moreover, fully alive to questions of sex, and is ready to assimilate a clean scientific view of its meaning. Personally I should find it very difficult to teach either botany or zoology apart from one another to these young boys.

Botany may be offered as a subject both for the Lower and School Certificates; but there is no indication from higher authority as to what should be included in a course of zoology for boys of this standard. It has been necessary, therefore, to substitute special syllabuses in biology of our own making, in order to enforce the inclusion of zoology in the examinations. Two examples are quoted below of the zoological content of biological syllabuses for the Lower Certificate:

A. Boys of 14½-15½, working four hours a week for three terms.

Elementary outlines of anatomy of following: Earthworm, Frog, Rabbit.

Prevention and destruction of insect pests, Elaters (wireworms), Tipulidæ (leather jacket), Aphididæ (woolly aphis).

Special scheme of Research Work.

(*a*) British Bird Life: (i.) Embryology; (ii.) General Anatomy of Birds. The mounting of specimens, examination of beaks and crops in connection with cultivation.

(*b*) Coleoptera, Lepidoptera, Hymenoptera.

(*c*) Anatomy of Farm Animals.

(*d*) Diseases of Animals; Blood.

(*e*) Insect Pests of English Fruit Trees.

One group only has been taken by any boy. Special work has been done by the whole form in preparation of charts, recording agricultural operations, bird life, etc., during the different seasons, and meteorological observations taken daily.

B. Boys of 14-15, working two hours a week for three terms.

A general knowledge of the Natural History of animals, with special reference to British forms (*e.g.* Rabbit, Pigeon, Frog, Snail, Butterfly, Spider). The study of pond life.

The general facts of fertilisation, and embryology of the frog and chick.

Use of the microscope for the study of Protozoa and Crustacea, also for parts of higher animals (*e.g.* scale of fish, feather, squamous epithelium from human cheek).

A general idea of organic evolution.

The above syllabuses, and others of a similar nature, have been successfully carried out. They are, however, open to criticism as not being suitable for wide application, especially in schools where monetary considerations constitute a limiting factor. In the absence of a recognised syllabus for a first introduction to zoology, and with a view of showing how the subject can usefully be introduced in any school, the writer has prepared a small text-book, the zoological syllabus of which is as follows:

Frog—External features, mode of life, respiration, alimentation. Development; breeding, segmentation, tadpole life, metamorphosis.

Earthworm—Habitat, mode of life, external features, general dissection, reproduction, soil action.

Fishes—Dogfish and Cod; habitat, mode of life, external features, development. Scales as a means of age-determination.

Arthropods—Crayfish, Bluebottle Fly, Garden Spider; habits, external features, life-cycle. Comparative table and summary of leading characteristics of each class.

Insect Pests—(An introduction to economic zoology.) Cabbage White Butterfly, Winter Moth, Cockchafer, Bean Weevil, Click Beetle (wireworm), Bean Aphis, Crane-fly (leather jacket), Larch Saw-fly.

Skeleton of the Vertebrate Fore-limb—Perch, Frog, Pigeon, and Rabbit. Comparative table.

Elementary conceptions of Variation and Heredity. Evolution.

The Microscope—Its use; suitable objects for observation. The nature of living matter; the cell. (For schools where the microscope is available.)

This syllabus is in close accordance with the general scope of teaching advocated by the British Association Committee, but is so condensed as to be covered by one hour's work a week throughout one school year. Types which, either through their limited distribution or their expense, may be difficult to obtain have been omitted; it is fatal to begin the study of zoology from a book instead of from an animal.

Finally, although a precise syllabus is necessary for the successful prosecution of class work during school hours, the best interests of zoology will never be served by that means alone. The museum and the aquarium must be going concerns, continually renewed and augmented by voluntary labour cheerfully given out of play-hours.

E. W. SHANN.

The School, Oundle, May 16.

EVERY teacher of biology in public schools will naturally welcome both the original memorandum of the British Association and also the article signed F. K. in NATURE of May 13, p. 628. The greatest difficulty in the teaching of biology at public schools at the present time is the position of the teacher. Unlike the teacher of so many other subjects the biologist is not turned out more or less a master of his subject, but is just in a position to begin to learn it, and the subject or subjects are so vast that if he is to do his work conscientiously he has a life's task before him. Of course this is more or less true of every other subject, but I think I am not in serious error when I say that a man with a good classical degree probably finds himself sufficiently well equipped to cope with the really intelligent boys of the upper sixth of the average public school.

So vast is the subject of biology, however, that the teacher cannot hope to cope with the really clever boy unless he is a real student of his subject, and even then of course his influence is that of a slightly superior but at the same time a fellow student, and not that of a master.

The teacher of biology, if he is to carry on his work successfully, must have an average knowledge of a great deal besides his text-book of botany or zoology. He must have a practical working knowledge of microscopy, pond-life, marine biology, field botany, including a reasonable knowledge of mosses, lichens, rusts, and other fungi. One knows, of course, that the mind of the average schoolboy is somewhat limited, but there are always a few that are capable of doing really good work, and for such boys the position of the master must be either one of suppression or that of a fellow-student, and one is seriously led to think that too often the work of the teacher is an act of suppression.

To sum up the whole position, a teacher of biology must be prepared to make his subject his life's work. It is lamentable, however, that even in some of the greatest of our public schools there is little room for the progressive student. The chief form of recognition or promotion consists of extra duty, and it is just this extra duty that puts an end to the idea of study. If a man is to teach biology properly he cannot hope to satisfy the demands of the head-master who looks for a colleague who will take an active part in the games of the school and a commission in the Corps, etc., and yet unless a man does do these things his chances of success in the scholastic world are poor. Of course things are improving and the high standard of work demanded by university scholarships is making the position of the true teacher a more important one.

I do not think, however, that F. K. is quite just when he advocates a vigorous protest against the opinions of examiners. The universities are naturally anxious to get hold of the best boys available, and they are surely the best men to select their material. We know that all examinations are more or less unsatisfactory, but they are the only possible method.

The chief fault lies in the lack of co-ordination between the university and the public school, and this is not altogether the fault of the university.

A. G. LOWNDES.

α-Particles as Detonators.

WHEN an α-particle passes through matter it may be considered that the matter in the proximity of the path of the swiftly moving particle is momentarily raised to a high temperature. Looked at in this light the action of an α-particle may be likened to that of a detonator and it may be possible to detonate a sufficiently unstable substance by the action of these particles. This has been found to be the case with the familiar explosive compound, nitrogen iodide.

The experiment forms a rather striking lecture demonstration. Nitrogen iodide is prepared in the usual way by the mixture of finely ground iodine and strong ammonia and allowed to dry overnight in the open air. On bringing a fairly strong radioactive source (say the active deposit of radium) within 3 or 4 cms. of the compound the iodide explodes. It may readily be shown by the use of screens of suitable thickness placed over the source that the result is due to α and not to β or other rays.

Detonation is not caused by the first α-particle which happens to strike the substance, but seems to be a probability effect. With a button of nitrogen iodide of about 0·1 $cm.^2$ area a source of radium-C equivalent in γ-ray activity to about 3 mg. of radium placed 1 cm. away causes the button to explode in about 20 seconds, *i.e.* when between 10^7 and 10^8 α-particles have struck it. Increasing the size of the button or the strength of the source decreases the time necessary. Quantitative measurements are not very accurate, as it is difficult to ensure identical conditions of experiment. Doubtless other unstable compounds might be found which would also be exploded in this manner.

G. H. HENDERSON.

Cavendish Laboratory, Cambridge, May 23.

Active Hydrogen and Nitrogen.

Two brief comments are suggested by the interesting work of Dr. F. H. Newman on the activation of hydrogen and nitrogen described in the *Philosophical Magazine* for March. The failure of the reaction product of the active nitrogen with sulphur, phosphorus, and iodine to give a test for nitrides is not evidence of the absence of a chemical reaction between those elements and nitrogen, for all three are more electronegative than nitrogen and the compounds formed would be sulphides, phosphides, and iodides, respectively. That this is in fact the case is shown in some experiments of mine with Dr. A. C. Grubb, which are now in process of publication, in which tests for sulphides and phosphides were actually obtained after exposing the corresponding elements to a stream of active nitrogen formed in the corona discharge. Our experiments did not include iodine.

Further, the evolution of gas when the bulb, in which these same three elements had been exposed to active hydrogen, was heated from −40° C. to 100° C. is not evidence of the failure of these elements to react with the active hydrogen, for the compounds formed would be hydrogen sulphide, phosphine, and hydrogen iodide, all of which are gaseous at the latter temperature though liquefied at the former, and would thus be evolved in the gaseous form when heated to increase the pressure as noted. Here again my experiments with Dr. R. S. Landauer and with Dr. William Duane, already published, show that phosphine and hydrogen sulphide are actually formed, the latter being confirmed by the dynamic method of Dr. Newman.

GERALD L. WENDT.

Chicago, Illinois, U.S.A.

IN reply to the comments made by Prof. Wendt, although no traces of the nitrides of sulphur, phosphorus, and iodine were found in the experiments on the activation of nitrogen, this was not unexpected, as it was considered highly improbable that any chemical compounds formed would respond to the nitride test. As the absorbed gas was not reliberated on heating, it appeared that chemical combination had taken place, the compounds so produced being very stable. Several other elements actually formed nitrides with the active nitrogen. These two facts suggested that chemical compounds were produced. The experiments of Prof. Wendt, now in the course of publication, seem to confirm this view.

As regards the action of active hydrogen on these three elements, it was found that at temperatures above 0° C., absorption of the gas occurred, although at a decreased rate. At these temperatures, if the chemical products formed are hydrogen sulphide, phosphine, and hydrogen iodide, they must be present in the gaseous state. There are other factors to be considered in order to account for the disappearance of the hydrogen, for the production of these gases will not explain the decrease in pressure. They are probably "trapped" within the solid present in the tube, and only reliberated on heating. Some of the gas which was evolved on the application of heat was re-absorbed when an electric discharge was passed through it, or when exposed to α-ray radiation. This re-absorbed gas was hydrogen, which may have been produced by the dissociation of the chemical compound formed originally, or it may have disappeared originally by occlusion within the solid. Although chemical action does account for the disappearance of some of the hydrogen, other processes, such as occlusion, have to be taken into account.

F. H. NEWMAN.

University College, Exeter.

A Supposed Ancestral Man in North America.[1]

By Dr. A. SMITH WOODWARD, F.R.S.

PROF. H. F. OSBORN has just described a water-worn small molar tooth from a Pliocene formation in Nebraska, U.S.A., as the first evidence of an anthropoid primate discovered in the New World. The specimen was found in the Snake Creek beds by Mr. Harold J. Cook, who has already made known numerous important remains of Pliocene mammals from Nebraska, some showing marked Asiatic affinities. With the aid of Drs. W. D. Matthew, W. K. Gregory, and M. Hellman, Prof. Osborn has determined the tooth to be a second upper molar, and he has named the unknown genus and species to which it belonged *Hesperopithecus haroldcookii*. It is nearly as large as the second upper molar of an American Indian, and its two diameters are almost equal. The kind of wear shown by its evenly concave coronal surface "has never been seen in an anthropoid tooth." In type the tooth is "very distant" from the corresponding tooth of the gorilla, gibbon, and orang; it is "still very remote" from that of a chimpanzee. It is also "excluded from close affinity to the fossil Asiatic anthropoid apes" represented by teeth found in India; and "it cannot be said to resemble any known type of human molar very closely." Indeed, "it is a new and independent type of Primate, and we must seek more material before we can determine its relationships."

The statements quoted make it difficult for one who has not seen the tooth to understand why Prof. Osborn even refers it to a Primate; and the published figures are not very helpful. The crown may be described as nearly triangular in shape, with bluntly rounded angles, a slightly raised and partially crimped rim surrounding a gently concave surface. The root is very massive, and at a considerable distance below the crown it becomes bifid, the smaller portion extended beneath one margin of the crown, the larger portion beneath and inclined towards the opposite apex. On one side of the root, between the bifurcation and the crown, there is an irregular indentation, from which Prof. Osborn supposes a third root-fang has been broken away. No stump of this third fang, however, is shown in the drawing.

In determining the tooth to be an upper molar, Prof. Osborn regards the edge with the smaller portion of root as external, and the tapering opposite end with the larger portion of root as internal. The hypothetically restored piece of root thus becomes posterior. It is, however, equally reasonable to interpret the so-called external border as anterior and the tapering end as posterior. If, then, the indented lateral portion of the root never bore another fang, the tooth becomes a lower molar. If this interpretation be admitted, comparison should be made not with any Primate tooth, but with the last lower molar in the primitive bears. In general appearance and shape the crown is very suggestive of that of the last molar in the lower jaw of some species ascribed to Hyænarctos and related genera; and as primitive bears of this group are already known by several fragments from the Pliocene of North America, material will eventually be available for comparison. The root of the last lower molar of Hyænarctos unfortunately appears to be unknown; but in the modern Ursus, in which the tooth in question is extremely variable, the root is often bifid, as in the new fossil from Nebraska, while between the bifurcation and the crown there is a hollowing of its outer face. There is, indeed, some reason to suspect that Hesperopithecus has received an inappropriate name.

[1] H. F. Osborn, "*Hesperopithecus*, the first Anthropoid Primate found in America," American Museum Novitates, No. 37 (reprinted, without figures, in *Science*, vol. 55, pp. 463-465, May 5, 1922).

Synthetic Dyes as Antiseptics and Chemotherapeutic Agents.

By Prof. C. H. BROWNING, University of Glasgow.

GENERAL interest in this subject has been recently stimulated by accounts in the daily press of a communication to the Society of Chemical Industry at Manchester by Messrs. Fairbrother and Renshaw.[1] The fact, however, ought not to be overlooked that much work has been in the past devoted to these problems by a number of investigators. That certain dyes of the triphenylmethane class possess marked antiseptic properties has long been known. Thus Stilling[2] in 1890 noted the powerful effect of ethyl violet on staphylococci (one of the commonest group of organisms which cause suppuration). He suggested the use of a mixture of allied dyes in the treatment of infective conditions, especially of the eye. But Stilling's suggestion found little favour with practical surgeons. As compared with phenol or mercuric chloride, the antiseptic dye-stuffs in general exert their lethal action on bacteria relatively slowly; thus, when tested by the usual method, in which only a brief period of contact between the organisms and the chemical agent is permitted, these dyes appear to act very weakly. It is probably for this reason that they were neglected.

The fact was overlooked that from the beginning of contact very high dilutions of antiseptic dyes may inhibit bacterial activity and that such "bacteriostatic" action can be utilised advantageously for therapeutic purposes. Churchman,[3] however, in America has investigated more recently the allied product, gentian violet, and has emphasised its value in the treatment of certain local pyogenic infections. The diaminotriphenylmethane dyes, malachite green and brilliant green, were shown to be actively antiseptic by Drigalski and Conradi[4] in 1902, and brilliant green has been applied with success in the treatment of infected wounds.

Investigations carried out with the view of comparing the antiseptic properties of various classes of dyes by Browning and Gilmour[5] confirmed the fact that a considerable number of basic compounds showed such action; the series of compounds which they investigated included the acridine group, triphenylmethane group, indamines, azine dyes (safranin), thiopyronin, and thiazines (methylene blue). A continuation of this work showed that of all the substances examined diaminoacridine derivatives ("acriflavine" and "proflavine") stand out on account of a combination of three characteristics, namely, high antiseptic potency, low toxicity for mammalian tissues, and insusceptibility to the interfering action of serum proteins, which diminish markedly the efficacy of all other powerful antiseptics hitherto tested. Therefore these substances, the antiseptic properties of which had not been recognised before, have been widely employed for the treatment of localised pyogenic infections, *e.g.* in wounds; when suitably applied, their use has proved highly beneficial. Recently also non-ionised compounds of mercury with dyes of the eosin group have been successfully used in America (mercurochrome of Young, White, and Swartz).[5A] In the case of generalised infections, however, the therapeutic problem is attended by much greater difficulties, and there is probably no synthetic compound so far available which will exert curative action in generalised bacterial infections in the human subject.

Selective Action.

When the antiseptic potency of a series of compounds is determined for organisms of various types, striking instances of selective action are met with, *i.e.* one compound will act very powerfully upon a particular organism and be relatively inert toward another; other compounds may exhibit the reverse order of activity on the same two organisms. Selective action of this kind was noted by Rozsahegyi[6] in 1887. Probably the most striking example of this is exhibited by the cyanine dye, "sensitol red," the ratio of the sterilising concentrations for *B. coli* and *Staphylococcus aureus* being probably greater than 2000 : 1 (Browning, Cohen, and Gulbransen).[7]

Relationships between Chemical Constitution and Antiseptic Action.

Within narrow limits, in groups of closely related compounds, certain laws have been established. In the triphenylmethane series, both with the diamino and the triamino derivatives, the substitution of methyl and ethyl groups in the amino radicals has been found to enhance the antiseptic action. Thus the penta- and hexamethyl triaminotriphenylmethane dyes, methyl violet and crystal violet, have been found by Dreyer, Kriegler and Walker,[8] and others to be more potent against staphylococci than the unsubstituted analogues, rosaniline or parafuchsine; similarly malachite green (the tetramethyl diamino derivative) and brilliant green (tetraethyl derivative) are much more powerful than the unsubstituted diaminotriphenylmethane dye, Doebner's violet.[5] In the acridine and azine series it has been established that potency of action in a serum medium is a characteristic of the diamino derivatives which have an alkyl group attached to the medial nitrogen atom (Browning, Cohen, Gaunt, and Gulbransen).[9] But general principles correlating chemical structure with antiseptic action cannot be formulated in the present state of knowledge. There is certainly no relationship between colour and effect on micro-organisms.

Action on Protozoa.

Ehrlich and Shiga[10] discovered that by means of injections of a benzidine dye, which they named trypan red, mice infected with the trypanosomes of the South American horse disease, *mal de caderas,* could be completely sterilised; thereby an otherwise acutely fatal infection could be cured. This work gave the impetus to the search for chemotherapeutic agents, and the greatest success achieved in this line has been the discovery of the "salvarsan" group of compounds by Ehrlich and his co-workers. In this department of research, again, it is impossible so far to enunciate general principles which should guide us in the search for effective substances. The therapeutic action is frequently not simply that of an antiseptic operating in the tissues and circulation of the infected animal; thus *in vitro* the parasites of *mal de caderas* are not killed by concentrated solutions of trypan red. Further, selective action is exhibited to a very marked degree by chemotherapeutic agents in protozoal infections; the efficacy of quinine in malaria and its relative inertness in trypanosomiasis is an instance of this. Certain compounds, however, are lethal for protozoa *in vitro* in concentrations which permit bacteria, of some species at least, to survive. Fairbrother and Renshaw suggest that such substances may be utilised with advantage in circumstances in which the process of bacterial purification of sewage fails, owing, it is believed, to an overgrowth of certain protozoa destroying the bacteria.

The search for chemical substances which shall exert curative effects in bacterial and protozoal infections appears to be well worth pursuing, since there are many diseases in which it would seem to be impossible to influence to a significant extent the natural defensive mechanisms of the body by procedures of specific immunisation; tuberculosis is an outstanding instance. But the successes hitherto achieved, especially in protozoal and spirochætal diseases (quinine in malaria, salvarsan in syphilis and other spirochætal infections, trypan blue in piroplasmosis, and emetine in amœbic dysentery), and the promising results in certain bacterial diseases (diaminoacridine derivatives, triphenylmethane compounds and mercurochrome in local pyogenic infections, and ethylhydrocuprein in experimental pneumococcus infections) are still more or less isolated phenomena. If it be possible to establish general principles in chemotherapy, this result will only be attained by much further investigation.

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The 700th Anniversary of the University of Padua.

By Prof. E. W. SCRIPTURE.

THE university of Padua was founded by professors who migrated from Bologna in 1222 owing to oppressive regulations. It very rapidly became great and famous. For nearly 500 years it was one of the leading universities of Europe.

The development of English culture and religion was strongly influenced by the earlier English students of Padua, comprising Linacre, Latimer, Tunstall, and Pace. English science received a splendid glory by Harvey's discovery of the circulation of the blood, in the anatomical theatre of Padua, and it was the inspiration of great thinkers, like his professors Galileo, Acquapendente and Casserio, that stimulated his active mind to a new thought. Evelyn, one of the founders of the Royal Society, was a student here; at his house many of the influential figures of England appeared. Sherard, who founded the chair of botany at Oxford, laid out the Oxford Botanical Gardens on the model of those of Padua, the oldest in Europe. Dr. Caius, the founder of Caius College, was also a student at Padua.

Viewed as a national university Padua is a brilliant success. Its medical school is excellently equipped. Its faculty includes Luccatelo (medicine), Bassini and Donati (surgery), Belmondo (psychiatry), and Casagrande (hygiene). It has a special school of hydraulics, a subject of such importance that Italy has established a special Ministry for it. Its equipment in geology and palæontology is in some departments unequalled anywhere else. In law it is almost, perhaps quite, the first place in Italy. In history the name of Manfroni at once comes to mind. When it is considered that all the students are post-graduate and professional (no undergraduate), Padua ranks certainly with the best universities of England and America.

The glory of Padua lies in the great men who once taught here, and in the splendid students it produced. It is worth while to inquire concerning some of the causes that produced not only its past greatness, but also that of Paris and Prag.

In the first place, the students of Europe were free to attend any university and to migrate from one university to another. Of course they went wherever they were attracted. At Padua the vast number—at one time 6000—was divided into partially self-ruling divisions according to nations. Padua, like Paris, Prag, Oxford, or Leyden, was a world-university.

The success of a university in attracting students depended on the quality of learning to be found. The best of professors were sought out by Padua; its roll of teachers included men of the rank of Galileo and Vesalius. The faculty, like the body of students, was international. The great mathematician Belmondi was followed in succession by Peurbach, Müller (Regiomontanus), and Paul of Middelburg.

To-day Padua is a purely Italian university. The 3220 students are all Italians, except for 47 foreigners (of whom 9 are Austrians). The Dutch universities ceased to be more than national affairs because Latin ceased to be the international language of learning, and no one would learn Dutch in order to study in Holland. This cannot be the case with Padua, because Italian, like German or French, is a language worth learning. That students will learn a language in order to study in a foreign country is shown by the great numbers of foreigners who studied in Germany before the war. The cause must be sought elsewhere.

Careful inquiry fails to find a single professor of the highest international fame now here, whatever the national reputation may be. This is one of the reasons for the change in Padua.

Students may attend a university on account of itself, regardless of the professors. This is the main force for most universities to-day except in Germany. A man goes to Oxford or Harvard because it is Oxford or Harvard, and not because there may be a famous man in his particular line. This determines successfully the large body of undergraduates as in English universities, but there is no undergraduate instruction at Padua. The principle becomes unfavourable when applied to a *graduate* university, as seen most strikingly in Padua. Its students, mainly from the north of Italy, attend in order to get their degrees, and afterwards their places and appointments. They become good lawyers, doctors, engineers, etc., but they do not receive the training in research and the inspiration toward originality of the olden days. The reflex on the university as an institution of research is unfavourable; Padua to-day does not hold the highest rank as one of the producers of modern thought.

The history of Padua shows clearly the faults of a system that attempts to build on any other principles than those of free migration of students and the appointment of distinguished professors of creative minds.

This condition may be illustrated by an impression received in London. Although Padua has been specially famous for its medical teaching—Vesalius, Fallopius, Morgagni—and its distinguished student Harvey, it was impossible to find in any medical library in London an account of Padua, except Sir George Newman's interesting address to the students of St. Bartholomew's. This lack of interest corresponds to—or produces?—a reciprocal feeling on the part of the Italians. Most noticeable is the fact that most of the students can speak German, while very few know anything of English.

A most striking feature of the celebration was the large attendance of foreign delegates. The British delegation comprised Sir Archibald Garrod (Oxford) the chairman, Lord Dawson of Penn (Royal College of Physicians), Sir Humphrey Rolleston (Royal College of Surgeons), the Astronomer Royal, Sir Frank Dyson, (Royal Society), Prof. Conway (British Academy), Prof. Okey (Cambridge), Prof. Caton (Liverpool), Mr. D. G. Hogarth (London), Prof. H. H. Turner (London), Sir William Smith (London), Mr. Chaston Chapman (London), G. M. Trevelyan (London), Father Cortie (Stonyhurst), Dr. Seton (London), Dr. Scripture (Philological Society), Prof. Burnet (St. Andrews), Dr. Baird (Glasgow), Prof. Barger and Dr. H. R. F. Brown (Edinburgh), Sir George Smith, Prof.

MacWilliam and Prof. A. C. Baird (Aberdeen), Prof. Martin (Glasgow), Prof. Fitzgerald (Belfast), Prof. O'Rahilly and Prof. J. F. D'Alton (Cork), Sir Robert Woods and Mr. E. H. Alton (Dublin).

The Canadian delegation included Prof. Bieler (Montreal), Sir George Parkin (Fredericton), Mr. R. C. Archibald (Sackville), Dr. O. Klotz and Mr. E. Deville (Toronto), Dr. H. Ami (Ottawa). The university of Sydney sent Mr. C. MacLaurin. India was represented by Prof. Chatterji and Prof. Mallik of Calcutta.

At the solemn ceremony on May 15 the delegates were classified in groups. England, Scotland, Wales, Ireland, Canada, and Australia formed one group. France, Spain, and the South American States formed another group. Strange new States also appeared. One group comprised Esthonia, Latvia, Finland, Poland, etc. Germany had its independent place, while the countries of Asia were ably represented by Prof. Chatterji of Calcutta, who made a charming speech in English and Sanskrit.

Current Topics and Events.

FIVE fellows of the Royal Society are included in the list of honours conferred on the occasion of the King's birthday, namely, Dr. H. K. Anderson, master of Gonville and Caius College, Cambridge, Prof. W. M. Bayliss, professor of general physiology, University College, London, Prof. F. W. Keeble, Sherardian professor of botany, University of Oxford, Dr. T. R. Lyle, formerly professor of natural philosophy in the University of Melbourne, and Dr. E. J. Russell, director of the Rothamsted Experimental Station. Among other names we notice those of Sir B. G. A. Moynihan, professor of clinical surgery, University of Leeds, who has been made a baronet, Dr. J. Macpherson, professor of psychiatry, University of Sydney, and Dr. W. Thomson, lately registrar of the University of South Africa, who have received the honour of knighthood, and Mr. A. E. Kitson, director of Geological Survey, Gold Coast Colony, who has been made a Companion of the Order of St. Michael and St. George (C.M.G.).

REPORTS have appeared in the daily press of plagues of caterpillars defoliating oaks, particularly on the borders of Surrey and Hampshire. They have also been observed in the wooded country near St. Albans. Large numbers of the caterpillars, suspended by silken threads from the branches of the oaks, are a common feature of such infestations, and are often an annoyance to people walking along woodland roads. The insect primarily concerned is *Tortrix viridana*: the moth of this species is a small insect with pea-green fore-wings and smoky brownish hind-wings. During the end of this month it will appear in myriads throughout the countryside wherever the caterpillars have been abundant. Fortunately there is only one generation in the year and, once the moths appear, there will be no recurrence of the caterpillars during the same season, and the trees commence to shoot out fresh leaves. The effect of the defoliation naturally checks the growth of the trees to some extent for the time being, but is rarely more serious, and infestations of this kind are very common during hot dry weather.

WE notice with deep regret the announcement that Dr. W. H. R. Rivers, distinguished by his brilliant work in anthropology and psychology, died on June 4, at fifty-eight years of age.

IT is announced that Mr. C. T. Heycock, Goldsmiths' Reader in metallurgy at the University of Cambridge, has been appointed Prime Warden of the Goldsmiths' Company.

THE centenary of the death of René Just Haüy, "the father of crystallography," occurred on June 3. Haüy, who was of humble parentage, was born at Saint-Just-en-Chaussée, Oise, February 28, 1743. After great privations and extraordinary exertions, at the age of twenty-one he became a teacher in the College of Navarre in Paris. Here he began the study of botany. An accident, however, with a crystal of calcareous spar attracted him to the examination of minerals and led him to the discovery of the law of crystallisation. The happy issue of this was that he gained the favourable opinion of Daubenton and Laplace, and in 1783 was elected a member of the Academy of Sciences. Though as an ecclesiast he stood in some danger at the Revolution and was indeed committed to prison, his numerous friendships and the esteem in which he was held secured him from serious trouble. He afterwards became one of the first members of the National Institute, was secretary to the commission on weights and measures, lectured at the Ecole Normale, and held a chair at the Jardin des Plantes. Edward Stanley, the well-known Bishop of Norwich, when visiting the Jardin des Plantes in 1814, wrote: "Here as everywhere else the utmost liberality is shown to all, but to Englishmen particularly, your country is your passport. . . . Haüy, you know, is the first mineralogist in Europe and I never looked upon a more interesting being. When he entered the lecture room everyone rose out of respect, and well they might. He is 80 years of age apparently, with a most heavenly patriarchal countenance and silver hair . . . he looked like a man picked out of a crystal, and when he dies he ought to be reincarnated and placed in his own museum." Haüy's brother, Valentin, was the inventor of raised type for the blind, and in 1903 a monument to both of them was unveiled at Saint-Just. There is also a monument to the Abbé Haüy in Paris.

IN his presidential address at the anniversary meeting of the Royal Geographical Society on May 29, Sir F. Younghusband, the retiring president, dwelt briefly on the need for more intensive geographical examination of the homeland. The spade-work of this form of exploration has of course been completed in topographical and geological surveys, faunas and floras and so forth, but the true geographical description is still far from complete. The bare facts are not enough: it is necessary to be able to seize the essential characteristics of a country and, discarding unimportant details, to bring those essential characters together in a connected whole, in order to give a clear and definite impression that will readily implant itself upon the mind. This work, Sir F. Younghusband said, does not involve the problem of transport: it can be done far better on foot, and the homeland explorer does not even require the qualification of youth. "We [must] gather to us men with eyes to see, and hearts to feel, and heads to think, who will be fired with enthusiasm to explore round about their own homes and then come here and describe to us what they have seen."

THE March number of the *Tropical Agriculturist* contains an account of the work at the Royal Botanic Gardens, Peradeniya, Ceylon, the centenary of the establishment of which occurs this year. In 1810 Sir Joseph Banks drew up a plan for a botanic garden which was established two years later at Colombo. In 1822 the work was transferred to Peradeniya, near Kandy, the site of the late Kandian king's garden, under the superintendence of Alexander Moon. The first plan of the garden, which was 147 acres in extent, is now in the Library of the Royal Horticultural Society in London. Work of development, begun in earnest in 1844, with the appointment of George Gardner, received a temporary check on Gardner's death in 1849, but in the next thirty years, under the superintendence of G. H. K. Thwaites, the gardens attained considerable fame. Thwaites was succeeded in 1880 by Henry Trimen (1880-1896) who, continuing Thwaites' investigation of the flora of the island, brought out the well-known "Handbook of the Flora of Ceylon." J. C. Willis succeeded Trimen, but retired in 1911, when the gardens were placed under the newly constituted Department of Agriculture. Peradeniya has played an important part in the agricultural development of the colony in connection with the introduction and acclimatisation of plants of ornamental and economic value. The chief interest was coffee until the industry was ruined by the coffee-leaf disease, when it was replaced by cinchona and subsequently tea. The rubber industry of the East owes much to the work in Ceylon, where seedlings were transferred from Kew in 1876; in 1906 the first of the World's Rubber Exhibitions was held in the Peradeniya Gardens. In 1887 a small botanical laboratory was fitted up in the gardens, and many British and Continental botanists have taken advantage of the facilities thus afforded for the study of botany in the tropics. In 1900 this was replaced by a larger well-equipped building.

THE third annual report of the Governors of the Imperial Mineral Resources Bureau, which has recently been issued, contains much interesting information. It is gratifying to see that at last a serious attempt is being made to adopt a unified system of mineral statistics applicable to the whole of the British Empire. This reform is long overdue, and it is to be sincerely hoped that the present effort will meet with success. The greater part of the report is devoted to a general review of the mineral industry of the British Empire and foreign countries for the year 1921, and the importance to the industry of such a comprehensive review at so relatively early a date can scarcely be overestimated. Even if the figures given are only approximately correct, they will serve as a trustworthy guide to the general trend of the industry. Unfortunately the picture is a very gloomy one, being a practically uniform chronicle of world-wide depression; almost the only exception is to be found in the coal production of Germany, which shows an appreciable improvement on that for 1920, and in the words of the report, "Considering the loss of the coal production of the Saar, the approach of Germany's fuel production in 1921 to the pre-war figures is significant."

A LECTURE on the mechanical construction of the microscope from a historical point of view, given by Prof. Alan Pollard before the Optical Society on April 27, dealt with the evolution of the instrument from the earliest times until about the middle of the nineteenth century. Prof. Pollard divided his subject into two main periods—the non-achromatic, in which the early history of the single lens or simple microscope was dealt with, and the achromatic. The mechanical details of outstanding historical compound instruments of these two periods which marked the progress of mechanical construction to the modern compound microscope, were described. Many famous instruments of the first period, such as John Marshall's "New Invented Double Microscope" of 1693, Culpeper's "Double Reflecting Microscope" of 1735, Cuff's "Double Constructed Microscope" of 1744, B. Martin's simple and compound instruments of 1765, Bleuler's "Universal" of 1788, Jones' "Most Improved" of 1798, by Dollond, Gould's "Pocket Microscope" of 1828, by Cary, as well as Lister's famous compound microscope, by James Smith in 1826, which marked the opening of the second period in this country, were set up with histological specimens so that their mechanical and optical performances could be compared. In addition, early catoptric instruments were shown, including Amici's reflecting microscope, made for Dr. Wollaston in 1830. The development in particular of the modern English limb from the Lister and Jackson designs, and the so-called continental limb from the early forms of Oberheuser and Nachet, was traced and described.

THE gold medal of the Linnean Society of London, which is given in alternative years to a botanist and a zoologist, was this year awarded to Prof. E. B. Poulton at the anniversary meeting on May 24. In making the presentation, the president, Dr. A. Smith Woodward, referred to Prof. Poulton's long labours in entomology, and his keepership of the Hope Collection at Oxford, transformed by him into a great museum, illustrative of variation, mimicry, and evolution. Prof. Poulton, in replying, mentioned the fact that half a century had elapsed since his matriculation at Oxford. At the same meeting of the Society the following officers were elected: *President:* Dr. A. Smith Woodward; *Treasurer:* Mr. Horace W.

Monckton; *Secretaries:* Dr. B. Daydon Jackson, Prof. E. S. Goodrich, and Dr. A. B. Rendle; *Members of Council:* Prof. Margaret Benson, Dr. G. P. Bidder, Mr. E. T. Browne, Dr. W. T. Calman, Prof. F. E. Fritch, Prof. E. S. Goodrich, Dame Helen Gwynne-Vaughan, Sir Sidney F. Harmer, Dr. Arthur W. Hill, Dr. B. Daydon Jackson, Mr. Gerald W. E. Loder, Mr. Horace W. Monckton, Mr. Frank A. Potts, Capt. John Ramsbottom, Dr. A. B. Rendle, Baron Rothschild, Dr. E. J. Salisbury, Mr. Charles Edward Salmon, Mr. Thomas Archibald Sprague, and Dr. A. Smith Woodward. Among the Vice-Presidents nominated for the present session appears the name of Dame Helen Gwynne-Vaughan, the first woman to attain that dignity, although it is nearly eighteen years since women were eligible for the fellowship, and for the last fifteen years they have been elected to the Council.

THE Council of the Institution of Electrical Engineers has made the following awards for papers accepted during the session 1921–22: the Institution Premium to Mr. J. G. Hill, the Ayrton Premium to Mr. L. H. A. Carr, the Duddell Premium to Mr. T. L. Eckersley, the Fahie Premium to Mr. E. S. Byng, the John Hopkinson Premium to Mr. F. P. Whitaker, the Kelvin Premium to Mr. R. Torikai, the Paris Premium to Mr. J. A. Kuyser, extra premiums to Mr. J. Anderson, Mr. F. J. Teago, and Mr. W. Wilson, wireless premiums to Mr. E. B. Moullin and Mr. L. B. Turner, and Mr. C. S. Franklin; and the Willans Premium, which is awarded triennially alternately by the Institution and the Institution of Mechanical Engineers, to Mr. K. Baumann.

THE British Non-Ferrous Metals Research Association, 71 Temple Row, Birmingham, has carried out an extensive research on the influence of gases on high-grade brass. A further investigation is now being started by the Association at the Research Department, Woolwich, in which the support of the Engineering Co-ordinating Board of the Department of Scientific and Industrial Research has been secured. The prime object of the present work is to study the conditions necessary for securing both surface and internal soundness of strip brass ingots such as are required for cold rolled sheet metal. The investigation should also throw light on other types of casting in non-ferrous alloys and should be of interest to a wide circle of manufacturers in the metal and engineering trades. Dr. Harold Moore and Mr. B. Genders will have charge of the research, which will be conducted partly in the works of members of the Association and partly in the Woolwich laboratories.

BEFORE the war the United States did not undertake the manufacture of optical glass; thus the disc for the 100-inch at Mt. Wilson was made at St. Gobain in France. The exigencies of war, however, made home-manufacture necessary, much help being given by the geophysical laboratory at Washington. The work was at first limited to the small lenses needed for military purposes, but after the Armistice it was greatly extended, and electric furnaces were constructed for annealing the glass, the rate of cooling being carefully controlled. In an article in *Popular Astronomy* of May, D. E. Sharp states that a 40-inch disc for a reflector for the Steward Observatory, University of Arizona, has now been completed by the Spencer Lens Co., Hamburg, N.Y. The glass employed has a low coefficient of expansion, and it is hoped that changes of figure due to change of temperature will thus be minimised.

A BRONZE medal to be designated the Faraday Medal of the Institution of Electrical Engineers will commemorate the fiftieth anniversary of the first Ordinary Meeting of the Society of Telegraph Engineers (now the Institution of Electrical Engineers). The award may be made by the Council not more frequently than once a year, either for notable scientific or industrial achievement in electrical engineering or for conspicuous service rendered to the advancement of electrical science, without restriction as regards nationality, country of residence, or membership of the Institution.

INVITATIONS have been issued by the Lawes Agricultural Trust Committee (Chairman, Lord Bledisloe) to inspect the experimental fields and laboratories of the Rothamsted Experimental Station, Harpenden, on Wednesday, June 14, when the Minister of Agriculture (The Right Hon. Sir Arthur Griffith-Boscawen) and the Parliamentary Secretary (the Earl of Ancaster) will be present.

THE seventy-seventh general meeting of the Institution of Mining Engineers will be held on June 20–22 at Sheffield. A preliminary programme has been issued, which provides for papers and discussions on stainless steels, rock temperatures in coal-measures, coal-mining methods and apparatus, and the absorption of carbon monoxide by the blood. A number of visits to works and collieries in the neighbourhood have also been arranged.

A PUBLIC meeting of the National Union of Scientific Workers will be held in the Botanical Theatre, University College, Gower Street, London, on Thursday, June 15, at 5.30, when an address will be given by Mr. F. W. Sanderson, Headmaster of Oundle, on "The Duty and Service of Science in the New Era." The chair will be taken by Mr. H. G. Wells. Admission will be free.

IT is announced in the *Chemiker Zeitung* of May 18 that Prof. Duparc of Geneva has, at the invitation of the Soviet Government, undertaken the organisation of the platinum industry of Russia.

THE movement for "birth control" has now assumed considerable proportions, and the Malthusian League, which numbers many persons of eminence in medicine, science, and literature among its vice-presidents, issues monthly the *New Generation*, a publication devoted to this subject and to problems of population. The "Mothers' Clinic," for information and advice on the subject, has been established and is open daily, and issues monthly the *Birth Control News*, which "intends to present to those who desire to see them shorn of the ephemeral, the real problems facing national and international statesmanship to-day."

Research Items.

THE SACRED HERAKLEOPOLITE NOME TREE.—In *Ancient Egypt* (Part 1, 1922), Dr. F. F. Bruijning concludes his interesting paper on the sacred tree of the Egyptian Herakleopolite Nome. From numerous representations of this famous tree on the monuments, he reaches the conclusion that it may be identified with the wine-palm, *Raphia monbuttorum*, which has since then retreated southward, keeping its place longest where the special conditions for its growth, a warm, damp air and soil, as in the oases, were favourable. Most of the so-called "artichokes" represented among the funeral offerings undoubtedly represent the palm-cabbage, and older interpretations, such as the theory that they represent pine-cones, must be set aside. A clear distinction must be drawn between palm-wine, obtained from the sap of various species, drawn by incisions in the spadix or head, or by cutting off the spadix, and date-wine in which, as with other fruits, the ripe fruit is mashed, pressed, or boiled, and then fermented.

THE OSAGE TRIBE OF AMERICAN INDIANS.—The Bureau of American Ethnology in its thirty-sixth Annual Report, 1914–15, publishes a fine, illustrated monograph on the Osage tribe by Mr. F. la Flesche. Marquette first visited them in 1673, and thus a trading relationship was established with Spanish and French merchants. In 1806 began the crisis in their history, by which they gradually relinquished their territory to the United States, and in 1825 they gave up their ancient home and removed to a reservation in Kansas. Their present quarters are in Osage County, Oklahoma, where they removed in 1872. They are rapidly, as a tribe, approaching extinction, not by death but by absorption by the whites, and only a small minority are now of pure blood. They belong to the great Siouan linguistic family, their nearest kindred tribes being the Omaha, Ponca, Quapaw, and Kaw. The volume contains, both in the tribal dialect and an English translation, a full account of their tribal rites—the Rite of the Chiefs, which records their traditions in a cryptic form, and the Hearing of the Sayings of the Ancient Men. They were accustomed to appeal daily to Wakonda for a long and healthful life. "Therefore at dawn, when they saw the reddened sky signalling the approach of the sun, men, women, and children stood in the doors of their houses and uttered their cry for divine help: as the sun reached mid-heaven they repeated their prayer: and their supplications again arose as the sun touched the western horizon."

BACTERIA ASSOCIATED WITH RICE AND OTHER CEREALS.—Starch is prepared from tubers and cereals, and of these rice probably holds the first place as a source of starch. The raw material is washed, steeped, and ground with water, so that the starch separates from other constituents of the grain, and the milky suspension is allowed to stand in tanks in which the starch is deposited. Fermentation due to bacteria is liable to occur, particularly during steeping and settlement, and may cause serious loss. The chief source of bacterial infection is the grain itself. It is found that "polished" rice carries more bacteria than "unpolished" (*i.e.* unhusked) rice, due apparently to the removal with the protective epidermis of the grain of an alkaloidal substance which has antiseptic properties. When not required for seed the grain may be sterilised by means of sulphur dioxide. Ordinary "paddy," rice grain as it comes from the fields, carries sporing bacilli which are capable of fermenting the starch with the production of acetone and butyl alcohol—as much as 8-9 per cent. of acetone on the weight of rice taken being obtained (G. J. Fowler and Dhiresh Zobhan Sen, *Journ. Indian Inst. of Science*, Vol. 4, Pt. VIII., p. 119).

MIGRATION INSTINCT IN BIRDS.—Mrs. C. D. Langworthy of Claygate, Surrey, raises the question of the migration of young cuckoos as an example of "inherited memory." The adult cuckoos, being free from family cares, emigrate very early and have all left the country some weeks before the young ones, which they have never seen, are ready for the journey. The young must thus find their way unaided. There is no evidence that the foster-parents' example plays any part; indeed the latter are frequently birds of sedentary habit. A similar phenomenon also takes place in the case of many other migrants, such as the starling, for example, but with the order reversed; the young migrate separately when only a few weeks old, the adults following later after completing their autumn moult. These cases are scarcely easier to explain than that of the young cuckoos, for it is difficult to imagine anything equivalent to theoretical instruction beforehand. Migration is a very regular phenomenon, occurring year after year according to the same plan; much of it, too, takes place before the need has become really apparent, and thus it cannot be explained simply as the result of immediate stimuli and of the pressure of external circumstances. It is therefore difficult to escape the conclusion, not only that the migratory habit is an inherited instinct, but that some foreknowledge of the journey to be performed is in some way inborn.

NEW DINOSAUR FROM NEW MEXICO.—Mr. C. W. Gilmore describes "A new Sauropod Dinosaur [*Alamosaurus sanjuanensis*, n. gen. et n. sp.] from the Ojo Alamo formation of New Mexico" ("Smithsonian Miscellaneous Collections," vol. lxxii., No. 14). The remains so far recovered consist of a left scapula and a right ischium, both in a good state of preservation. The great importance of these particular bones lies in the fact that the remains of sauropodous dinosaurs have not previously been known to occur above the Lower Cretaceous in North America, so that the extension of their geological range into the Upper Cretaceous is of the greatest palæontological and geological interest. Much doubt attaches, in Mr. Gilmore's opinion, to the proper identification, or exact geological position, of the reported finds in other parts of the world of sauropod remains of Cenomanian age or later, although such dinosaurs doubtless continued to exist until after the Cenomanian and even into the Danian.

NEW SURVEYS IN ARABIA.—The *Geographical Journal* for May contains a new map of northern Arabia prepared by the Geographical Section of the General Staff. The map incorporates the work of the late Capt. W. H. I. Shakespear, especially his great journey across Arabia in 1914 from Koweit on the Persian Gulf to the Egyptian outpost of Kuntilla in Sinai. These observations were utilised during the war in the construction of the 1/M map of Arabia, from which the present map is reduced to the scale of 1/1·5 M. Mr. D. Carruthers, in an article accompanying the map, points out that Capt. Shakespear's trans-Arabian journey covered about 1200 miles of unknown country and that for the whole distance, 1810 miles, he kept up a continuous route traverse, checked at intervals by observations for latitude.

Hypsometric readings for altitude were also taken. The new work included the first complete traverse of the Wadi er Rumma in its lower course, el Batin; the region southward to Zilfi and thence to Riyadh; much new detail between Riyadh and Buraida; and a completely new route from Buraida to Jauf and between Jauf and the Wadi Araba on the frontier of southern Palestine.

DEATH VALLEY.—An article is given in the U.S. *Monthly Weather Review* of January last by Mr. Andrew H. Palmer of the U.S. Weather Bureau on the weather at the Bureau's substation at Greenland Ranch in Death Valley, California. The valley extends from north to south for a distance of about 100 miles, and lies between high mountain ranges. The width varies from two to eight miles, and it is the deepest depression in the United States. The instrument shelter is 178 feet below sea level, and the maximum and minimum thermometers with the thermometer screen, as well as the 8-inch rain gauge, are lent by the Weather Bureau. Unbroken weather records are now available for more than ten years. Nearly every summer the highest temperatures observed in the United States occur in Death Valley. The extreme maximum temperatures recorded during the last eleven years, to 1921, range from 134° F. in 1913 to 120° in 1912; the extreme of 134° F. observed on July 10, 1913, is said to be the highest natural air temperature ever recorded on the earth's surface by means of a tested standard thermometer exposed in a standard louvered screen. Temperatures of 100° or higher occur almost daily during June, July, and August; in July 1917 the mean temperature was 107°·2. Not infrequently six consecutive months have passed without measurable rain. In 1917 the total rainfall was less than half an inch, and the annual average precipitation is less than two inches. There is said to be some sunshine during practically every day in the year. Four crops of alfalfa are gathered each year.

GEOLOGICAL RESEARCH AND EDUCATION IN CONNECTICUT.—The Connecticut State Geological and Natural History Survey has collected its bulletins issued between 1915 and 1920 as volume vi. of its publications, which are distributed gratuitously "to public libraries, colleges, and scientific institutions, and to scientific men, teachers, and others who require particular bulletins for their work, especially to those who are citizens of Connecticut." The present thick but easily opened volume contains over 1100 pages, with abundant plates, maps, and other illustrations. Geologists will welcome Prof. R. S. Lull's treatise on "Triassic Life of the Connecticut Valley," as a record of life and conditions on the land at the opening of Mesozoic times. We are present, as it were, at the rise of the dinosaurs, and the original restorations serve admirably to impress the characters of these dominant forms on the minds of every teacher in the schools. Podokesaurus, recently discovered and described by Miss M. Talbot, is fully discussed and illustrated, for comparison with its Upper Jurassic ally, Compsognathus. A complete review is given of the footprints that abound in the shales and sandstones, especially in the upper beds of the system; some may represent amphibia, but the associated bones show that many must be ascribed to dinosaurs. Bulletin 26, by Prof. V. W. Kunkel, describes the existing amphipod and isopod Crustacea of the State, and Dr. W. C. Britton gives a list of the insects, occupying 400 pages.

THE FLOTATION OF CONTINENTS.—Prof. Wegener's views on continental movement were stated in a recent review (NATURE, February 16, p. 202) of the second edition of his work on "Die Entstehung der Kontinente und Ozeane." His daring suggestions were formulated in 1912, and we cannot quite dismiss them as Prof. L. Kober does, by saying "im Bau der Erde hat die Theorie der grossen Kontinentalverschiebungen keine Stütze." However much we may doubt the horizontal movement of masses of "sal" across uncrumpled "sima" areas, the proposition that has arisen in the mind of a geographer can be met only by argument on the part of the geologist. Prof. Wegener has contributed to *Discovery* (vol. iii. p. 114, May 1922) a lucid summary of his conceptions, accompanied by maps, showing, among other wonders, the transference of the Deccan to the antarctic region in Carboniferous times. A polar ice-cap, spreading across the conference of continents here cunningly arranged, would not explain the movement of an ice-sheet from north to south in southern Africa. Mr. A. L. du Toit, however, in two notable papers dealing with former land-connections and the glaciation of South Africa (*S. African Journ. Sci.*, vol. xviii., Dec. 1921, and Trans. Geol. Soc. S. Africa, vol. xxiv. p. 188, 1921) welcomes the new hypothesis. His map of Gondwanaland as promoted by flotation, with its arrows showing the direction of ice-movements, seems to require a snow-dome near the south of Madagascar, and a separate glaciation of Australia by the polar cap. We should like to study Prof. Wegener's explanation of the arid climates of the Trias, and of the cold conditions prevalent over the whole earth in the latest glacial epoch. For him, New Zealand (see NATURE, vol. 109, p. 657) has been left behind by the westward drifting of Australia, and his "Old Quaternary" map does not explain its glaciation on geographic grounds. The Carboniferous map shows a general submergence of Eurasia, so that his seeming repudiation of vertical movements in accounting for changes on the earth's surface may be something like the waving of a red flag at the head of an orderly industrial procession. We shall hope for a thorough discussion of his proposals in the light of what is known as to marine transgressions across the continents.

EFFECT OF LIGHT ON MUSEUM SPECIMENS. — The *Museums Journal* for April contains a detailed account by the Director of the Natural History Museum of the careful experiments that he has conducted there for many years, with the help of the late W. G. Ridewood, on the fading of colour in museum specimens. Direct sunlight is, says Sir Sidney Harmer, far more injurious to colours than any other method of illumination, and diffused daylight appears to produce more fading than any form of electric light used. This statement applies to oil-colours as well as to water-colours and the colours of various animal coverings, and suggests caution to those who, on the advice of Sir M. H. Spielmann, would put their oil-paintings in a blaze of sunlight. The various glasses designed by Crookes and others to cut off the more deleterious rays were not found sufficiently satisfactory to warrant the expense of their installation. The practical conclusion of the whole matter is that direct sunlight should be avoided at all costs, and that even diffused daylight should be shut out at all hours when exhibition galleries are closed to the public. At other times the light, if at all bright, should be moderated by yellow blinds. A gallery lighted entirely by electric light, preferably in the form of half-watt lamps, would have great advantages. The paper is one that should be studied by all directors of museums, including art galleries.

The International Union of Geodesy and Geophysics.

THE first meeting of the General Assembly of this Union, which was held at Rome at the beginning of May, was attended by delegates from the fourteen countries which at present form the Union, and also by a number of representatives from several other countries which, though belonging to the International Research Council, have not yet joined the Union.

The Union, which was constituted at Brussels in 1919, has for its object the promotion of the study of geodetic and geophysical problems and of international co-operation in research. It covers not only the ground with which the former International Associations of Geodesy and Seismology dealt, but its sections provide for similar activities in meteorology, terrestrial magnetism, physical oceanography, vulcanology, and scientific hydrology.

The meetings of the Union and its constituent sections were held in the rooms of the Reale Accademia dei Lincei on May 3–10, and were preceded by an official reception of the delegates and members of the Astronomical and of the Geodetic and Geophysical Unions by the Minister of Public Instruction at the Capitol, at which His Majesty the King of Italy was present.

As the meeting in Brussels in 1919 was held for the special purpose of constituting the International Research Council and the Unions which are related to it, no scientific discussions took place there; since then the organisation of the Union and its sections has entailed a considerable amount of work. At Rome, therefore, each section had to prepare its plans for international work, and in the case of geodesy and seismology, to review the progress which had been made since the last international meeting. In all sections good progress was made, and plans were adopted for the work which will be put in hand in the period which will elapse before the next meeting of the Union in 1924.

In geodesy the programme was a heavy one, for ten years have elapsed since the last meeting of the International Geodetic Association at Hamburg in 1912. Very interesting summaries of the work which it has been possible to carry out during this period were presented by the delegates of the various countries, and these will be published in the report of the section of geodesy. It had been suggested at Brussels that the study of variation of latitude should be confided to the Union of Astronomy instead of to that of Geodesy. The question was fully discussed at Rome by a committee representing the two Unions, and it was decided that the subject should remain with the Section of Geodesy, a joint committee of geodesists and astronomers, with Prof. Kimura as chairman, being appointed to direct the work.

To carry out the decisions of the Section, and to deal with any matters which might arise, an executive committee was appointed, as well as a General Committee, on which each country adhering to the Section will be represented. The General Committee will be consulted on matters which go beyond the powers of the executive committee in the interval between two meetings.

For each principal branch of technical work a reporter was appointed who will prepare a statement on the progress made in it for the periodical conferences, and will also facilitate co-ordination between workers in different countries. Mr. W. Bowie of the U.S. Coast and Geodetic Survey continues as president, with Lieut.-Colonel G. Perrier of the French Geodetic Service as secretary.

As the International Seismology Association was still in being at the time of the Conference at Brussels, no change could then be made, and the Section of Seismology was only constituted at Rome, when Prof. H. H. Turner, of Oxford, was elected president, with Prof. Rothé of Strasbourg as secretary. The subjects for discussion included the study of microseisms, the depth focus of earthquakes, and proposals for studying explosion phenomena and wave propagation. Much work was done in organising the Section, and in planning work to be undertaken before its next meeting. The work now being done at Oxford and at Strasbourg is to be carried on, and to this the Section will give such assistance as it can.

Meteorology is represented in the Union by a Section which is a new organisation in so far as it does not replace a pre-war institution of a corresponding character. Its relations to the International Meteorological Committee, which has been in existence for many years, came up for discussion; this committee consists of a certain number of Directors of meteorological services, and at its periodical conferences, such as that which met at Paris in 1919, many questions are discussed which arise from the relations existing between the meteorological services of different countries. It was agreed that, in addition to questions of this character, there were many investigations for which international co-operation was essential, which directors of meteorological services might find it difficult to include in their work. Such investigations might with advantage be initiated by the Section, and at Rome plans were discussed for work of this character. The composition of the atmosphere at high altitudes, and the physical conditions prevailing in the stratosphere, were specially considered as being subjects in which an increase of our knowledge is highly desirable, and plans for work upon them were adopted. It is clear that the two organisations would in no way overlap, but that the work of each would usefully supplement that of the other. Sir Napier Shaw was elected president of the Section, with Prof. Eredia of the Italian Meteorological Service as secretary.

The Section of Terrestrial Magnetism and Electricity was fully occupied with a long programme dealing largely with methods of observation and with the reduction of results; no particular method of scale-value determination was agreed upon in view of the diverse types of instruments in use. The selection of one observatory in each country which should take part in the international comparison of instruments was advocated, and a committee was appointed to formulate a scheme for such intercomparisons. Other committees were formed to deal with polar-light observations, with earth currents, and observational work in atmospheric electricity. Dr. C. Chree was elected president, with Dr. L. A. Bauer as secretary.

The Section of Physical Oceanography had held one meeting in Paris in January 1920, at which committees were nominated to facilitate co-operation in oceanographical work in the Atlantic, in the Pacific, and in the Mediterranean. At Rome these were confirmed, and the recommendations of the Tidal Committee for improving the collection of tidal information and data, and for attaining uniformity in their reduction, were adopted. A proposal to provide, by means of a committee or a section, for the co-ordination of biological work in oceanography with the physical work of the Section, was adjourned until the next conference in order that opinions from various countries might be obtained. H.S.H. the Prince of Monaco continues as president, with

Prof. G. Magrini of Venice as secretary. The publication of a periodical which would deal specially with the bibliography of the subject was also approved.

In the Section of Vulcanology, which was formally constituted at the Conference, M. Lacroix was elected president, with Prof. Malladra and Prof. G. Platania as secretaries. Proposals for the classification of volcanic phenomena, and for the recording of volcanic outbursts, were adopted, as also were those for the investigation of the thermal gradient in certain areas.

In more than one quarter the proposal had been made that an additional section should be formed to deal with the scientific problems which arise in various hydrological investigations, such as river-gauging, lake phenomena including seiches, run-off and evaporation, transport of material in suspension and in solution, glacier movement, etc. A committee examined the matter carefully and reported in favour of forming a Section of Scientific Hydrology. The recommendation was adopted by the General Assembly, which nominated Mr. B. H. Wade of the Physical Department, Cairo, as president, and Prof. G. Magrini as secretary.

The General Assembly of the Union re-elected M. Ch. Lallemand to be president, Colonel H. Lyons remaining secretary-general. It was resolved that countries belonging to the International Research Council which had formerly been members of the International Geodetic Association might join the Union and the Section of Geodesy, without subscribing to the other sections, if they so desired. It was further resolved that the next meeting of the Union should be held in 1924, and an invitation from the Spanish Government to hold the next Conference of the Union at Madrid was accepted. It is understood that the probable date will be the latter part of September.

Arrangements were made for members to visit, after the Conference, the Central Institute for Marine Biology at Messina, and the Marine Research ship *Marsigli*. For those interested in vulcanology visits to Stromboli, Catania, Etna, and Naples were arranged, while at Florence the Observatory and the various scientific institutes and museums were open to the members, to whom the municipality gave a reception at the Palazzo Vecchio.

The proceedings in each Section will be published in due course by the Executive Committee of the Section.

H. G. L.

Annual Conference of Universities.

ALL the Universities of Great Britain and Ireland were represented at the Conference which met at University College, London, on May 13. Each University had been asked to send three representatives in addition to its executive Head, and each University College to send its Principal and one other representative. Of the Vice-Chancellors or Principals three only were unable to attend. Sir Donald MacAlister (Glasgow), chairman of the Standing Committee of Vice-Chancellors, presided. Mr. Fisher, President of the Board of Education, was present and took part in the discussions.

The subject of the urgent need for the provision of enlarged opportunities for advanced study and research was introduced by Principal Irvine (St. Andrews), who pleaded that the Universities should not leave original research to the solitary worker, but should place facilities for research in the way of every one naturally equipped with the spirit of inquiry. It is impossible to summarise Principal Irvine's address, but the main contention was that training in research should be in the hands of mature investigators who should be relieved of all routine and administrative work. Principal Sibly (Swansea) said that the importance of the applications of science had become so clear to the public during the war that technological studies were now greatly favoured and the opportunities of prosecuting pure science were actually narrower than they were ten years ago. Sir Richard Lodge (Edinburgh) sounded a warning that training may be overdone. Many a research worker, left to himself, has learned more from his blunders than from his supervisor's advice. He emphasised the value of the Institute of Historical Research, which should, he thought, have a semi-federal character and be regarded, not as the possession of a single University, but in some degree, as common to all, since all historians must come to London to consult the documents which they need for the purposes of research. In this he was supported by Principal Grant Robertson (Birmingham).

The need for an increase in residential accommodation for students was urged by Sir Michael Sadler (Leeds), who stated that the desire for college life had recently been greatly strengthened in the newer Universities. In part it has been met. The increase in accommodation during the past year amounted to no less than 17 per cent. But very much more is needed. Women students equally with men recognise that, unless they share in the corporate social life of a Hall of Residence, they do not reap the full benefit of a University career. A very valuable discussion of the details of organisation and management followed, in which various speakers, drawing upon their own administrative experience, stated, amongst other things, that they had found that from 65 to 75 students is the economical unit (Principal Childs would place the number somewhat higher), that the Halls (the term "Hostel" was generally disapproved) should be independent of the Universities, that younger members of the staff should be encouraged to live in the Halls, that discipline and even management must be largely in the hands of the students, and that students must have some degree of privacy. It was agreed that no teaching should be given in the Halls. The most desirable situation for Halls in industrial towns was also discussed. For health and recreation they should be grouped around the playing-fields. This means that the residential quarters will be at a distance from the University buildings. Danger will arise, in consequence, of a division of the University into two groups of students with different centres of patriotism. This can be met by the provision in the immediate neighbourhood of the University of commodious "Union" buildings, and by encouraging the students who live at home or in lodgings to found a "Hall" with a warden and elected officers.

Dr. L. R. Farnell (Oxford), in introducing the subject of specialisation in certain subjects of study by certain Universities, argued that the time has passed when every University can attempt to foster all the shoots which are constantly being thrust forth by the tree of knowledge. Some flourish only where local conditions are favourable, others are so esoteric that a few centres will satisfy the needs of all their votaries. Mr. Fisher endorsed the views of the Vice-Chancellor of Oxford. When the Government gave their support to the Universities Bureau they did so with the view of inducing the Universities to take counsel together, to encourage co-operation, and to enable overlapping to be avoided, without that external interference which they all deprecated. The development of applied science has reached dimensions which make it imperative, if the nation as a whole is to advance, that much more consideration than has hitherto been thought necessary should be given to the distribution of studies. The more conference there is between those responsible for University policy in England and Scotland the better it will be, especially if we are to look forward to a certain number of lean years. He suggested that the Vice-Chancellors' Committee be asked to consider (1) what new specialist departments, requiring for their development new endowments, may be appropriate to particular Universities; (2) whether existing trust funds in particular Universities could be applied to better uses within those Universities; and (3) whether the statutes of the different Universities could be so altered as to facilitate migration, in order that students may obtain specialist teaching. The chairman promised to report Mr. Fisher's proposals for inquiry to the next meeting of the Vice-Chancellors' Committee.

The subject of the Organisation of Adult Education as an integral part of the work of the Universities was introduced by Sir Henry A. Miers (Manchester), chairman of the Conjoint Committee of the Universities and the Workers' Educational Association, who pointed out the desirability of bringing into co-operation many bodies in addition to the one in which he is especially interested. He and subsequent speakers emphasised the importance of restricting the expression "Higher Education" to its legitimate sense as such a standard of education as only Universities can provide. There is a real danger of the Universities, moved by sympathy for those who have done great things in the way of making good early deficiencies, accepting as "higher," education which is not of a University type. There is also danger of trade-unions imagining that they can employ imperfectly trained persons as instructors. Mr. R. Peers, head of the Department of Extra-mural Teaching, gave a very interesting account of the organisation of Adult Education undertaken by the University College of Nottingham.

The Centenary of the Royal Astronomical Society.

THE actual date of the centenary of this Society was February 1920. Prof. A. Fowler, who was then president, delivered an appropriate address on that occasion, recapitulating the circumstances of the origin and early history of the Society. It was felt, however, that the conditions of foreign travel were still too difficult to render the occasion suitable for a full celebration of the event. Early in the present year it was thought that it would be well to take advantage of the presence of a large number of astronomers in Rome, at the meeting of the International Astronomical Union, many of whom, it was hoped, would be able to visit London on their way home. The end of May was therefore chosen as the date for the celebration, which was attended by a considerable number of associates.

The celebration opened with a conversazione on May 29, for which the Royal Society kindly lent its rooms; more than 300 guests were present; the exhibits included a collection of Newton relics, a number of ancient astronomical and mathematical books, calculating machines, and a model illustrating the probability curve. Five short lectures were delivered in the meeting room, on Sunspots, Planets, Comets, Instruments, and an anecdotal lecture on some former Fellows.

The morning of May 30 was devoted to addresses on the history of the Society. Prof. Eddington, the president, read the loyal message which had been sent to the King, as Patron of the Society, also his gracious reply, of which the following is an extract:

"You can rest assured that the King watches with interest and admiration the patient, diligent, and unobtrusive manner in which the Fellows of the Society conduct their unremitting research, in the hope that they may, by piercing the hidden mysteries of the skies, add step by step to the store of scientific knowledge, and thus contribute so much that is essential to the progress of mankind on land and sea."

He then read messages from many of the absent associates, which spoke of the great work that the Society had done for astronomy during the century of its existence, and expressed confident hope that its future would be equally fruitful. Similar messages of congratulation were received from many scientific societies.

The inaugural address by the president was a general survey of the progress of astronomy during the century; he suggested the following six events as marking definite steps of progress: 1839, the first stellar parallaxes were measured by Bessel and Henderson; 1846, Neptune was discovered as a result of the solution of the problem of inverse perturbations by Adams and Le Verier; 1854–58, the commencement of astronomical spectroscopy by Huggins and Lockyer; 1882–87, the beginning of stellar photography; 1904, Kapteyn's discovery of the two star-streams, which led to the beginning of stellar dynamics; 1920, the first direct measure of a star's diameter, by the Mt. Wilson interferometer. On the whole the twentieth century has been marked by the shift of the main interest from the solar to the stellar system. The former, however, is not entirely neglected; Prof. Eddington instanced planetary photography, the discovery of new faint satellites, and the Trojan group of asteroids, Einstein's explanation of the motion of Mercury's perihelion, the work of Taylor and Jeffreys on tidal friction in the Irish Sea, and Jeans's work on the cosmogony of the solar system.

Dr. Dreyer then delivered an address on the history of the Society, referring to the low ebb that astronomy and mathematics had reached in England before its foundation. One reason given was the continuance of the clumsy fluctional notation, which had already been superseded on the continent. One method attempted for encouraging research did not meet with great success; this was the offer of prizes for the solution of certain problems; it was noted that the prize offered for the mathematical treatment of the Saturnian satellite system met with a reply 80 years later, when Dr. Hermann Struve was awarded the Gold Medal for his work on Saturn's system. Reform of the Nautical Almanac was another work in which the Society interested itself. It awarded the Gold Medal in 1830 to Encke for his improved Berliner Jahrbuch; in 1834 our own Almanac followed suit. In 1835 the Society was given rooms in Somerset House, where it remained till it occupied its present abode in 1874. Allusion was made to the absorption of the Spitalfields Mathematical Society in 1845; it enabled them to claim that in a sense they were keeping their second centenary, since that Society went back to 1717. Most of their old mathematical books were acquired from that Society. Allusion was made to the invaluable services of two assistant secretaries, Mr. Williams, known for his studies of Chinese comet records, and Mr. W. H. Wesley, who had now held that office for 47 years; much to their regret, illness prevented him from taking part in the centenary celebration. Allusion was made to the Society being consulted on the question of the remeasurement of the fundamental arcs in the British survey, and to the granting of the new charter in 1915, permitting the election of lady Fellows.

Prof. Turner followed with a biographical address, illustrated by portrait slides; he began with Queen Victoria, who had been their Royal Patron during two-thirds of their existence. He noted that former kings of Denmark and Siam had been honorary members, a distinction also awarded to Caroline Herschel, and several other famous lady astronomers, the latest being Miss Annie Cannon. The portraits included Sir W. and Sir J. Herschel, Francis Baily, Daniel Moore, Stephen Groombridge, Mr. Colebrook, Richard Taylor (first editor and printer of the Monthly Notices, and founder of the firm of Taylor and Francis).

The afternoon meeting was opened by the reading of the minutes of the preparatory meeting held at Freemason's Tavern, Gt. Queen St., Lincoln's Inn Fields, on January 8, 1820, at which Mr. Daniel Moore was chairman, the fourteen persons present all signing the declaration that they would help to forward the formation of the proposed Society.

Six of the Associates present were then invited to speak on their recent work. Dr. Seares spoke on the systematic differences of colours of giant and dwarf stars of the same type, the dwarfs being redder; he also discussed absolute magnitude as a function of galactic latitude. Prof. Strömgren spoke on solutions of the three-body problem by mechanical quadratures. Prof. H. Shapley spoke on his recent work of finding absolute magnitudes from objective prism spectra; also on the local cluster round the sun, stated to be 2000 light-years in diameter, and on the recent discovery of faint Cepheid variables in the Magellanic Cloud.

Dr. Hertzsprung spoke on the Cepheid variable RR Lyræ, showing that it has several superposed periodicities.

Dr. Aitken dealt with double stars, stating that his special aim was to form an exhaustive catalogue of all doubles down to the ninth magnitude within certain limits of distance. He stated that 15 per cent. of his discoveries already show orbital motion.

Dr. St. John spoke on the absence of the lines of oxygen and water vapour from the spectrum of Venus, stating that one metre thickness of each would have sufficed to give a register. He mentioned that the rotation of Venus is probably at least 15 days. The Einstein shift in the solar spectrum is still engaging attention. If present it is evidently partially masked by some other cause; the shift towards the red that is found is not proportional to wave-length.

The Society dined at the Criterion Restaurant in the evening. Lord Balfour was the guest of honour, and proposed the toast of the Society in felicitous terms, the president making a suitable reply.

On Wednesday the Fellows and Associates were the guests of the British Astronomical Association.

On Saturday, June 3, the Society was entertained by the Astronomer Royal at Greenwich on the occasion of the annual Visitation of the Observatory.

A. C. D. CROMMELIN.

University and Educational Intelligence.

LEEDS.—An open fellowship of 200*l*. per annum, established by the Institution of Gas Engineers, is offered for the prosecution of post-graduate research in gas chemistry. Applications will be received by the Registrar of Leeds University until June 19.

LIVERPOOL.—Honorary degrees were conferred at a special Congregation of the University held on May 19. The Bishop (the Right Reverend Francis James Chavasse), Mr. Justice Pickford (Baron Sterndale), and Sir Henry Alexander Miers, vice-chancellor of the University of Manchester, received the degree of doctor of laws; Dr. L. P. Jacks, Principal of Manchester College, Oxford, and Editor of the *Hibbert Journal*, that of doctor of letters, and Sir Charles Sherrington, Waynflete professor of physiology in the University of Oxford and president of the Royal Society, that of doctor of laws. For eighteen years Sir Charles Sherrington was the George Holt professor of physiology at Liverpool, and his services to the University College and University during that period are now remembered with deep affection and gratitude. The degree of doctor of engineering was conferred on Sir John A. F. Aspinall. Sir John Aspinall was for years chairman of the faculty of engineering at the University, and the present highly developed condition of the series of departments that now constitute the faculty is very largely due to the powerful influence that he exerted on its behalf. His professional career has seen the development of some highly important methods of modern railway transport.

LONDON.—The following Doctorates have been conferred:—*D.Sc. in Chemistry*: Mr. G. A. R. Kon, an internal student of the Imperial College—Royal College of Science—for a thesis entitled "The Influence of Space Conditions on the Formation of Strained Rings; The Formation and Stability of *spiro*-compounds." *D.Sc. in Cytology*: Mr. J. B. Gatenby, an internal student of University College, for a thesis entitled "The Cytoplasmic Inclusions of the Germ-cells: Part X.—The Gametogenesis of Saccocirrus." *D.Sc. in Physics*: Mr. L. C. Martin, an internal student of the Imperial College—Royal College of Science, for a thesis entitled "A Physical Study of Spherical Aberration." *D.Sc. in Physiology*: Miss Gladys A. Hartwell, an internal student of King's College for Women (Household and Social Science Department) and Bedford College, for a thesis entitled "Mammary Secretion." *D.Sc. in Botany*: Mr. W. J. Hodgetts, an external student, for a thesis entitled "A Study of some of the Factors controlling the Periodicity of Freshwater Algæ in Nature," and other papers.

Applications are invited for a Sharpey physiological scholarship at University College. The scholarship is of the value of 200*l*. Applications, with a full statement of the candidates' academic training and a list of their publications, if any, should reach the secretary of the college, Gower Street, W.C.1, not later than June 15.

A DRAPERS' COMPANY'S research scholarship in dyeing and a research scholarship in colour chemistry, tenable for the session 1922–23 at the Huddersfield Technical College, are offered. The value of the first-named scholarship is 100*l*. and remission of fees, and that of the last named not more than 100*l*. and remission of fees. All particulars and forms of application may be had from the secretary of the college.

Calendar of Industrial Pioneers.

June 10, 1850. James Smith died.—Educated at Glasgow University, Smith was placed in charge of his uncle's cotton-works at Deanston, Perthshire, where he introduced many improvements in manufacture and agriculture. He invented a reaping machine, improved the self-acting mule, built bridges and waterwheels, in 1813 lighted his factory by gas and introduced the sub-soil plough and the deep draining of soils.

June 11, 1843. Alexander Forsyth died.—The inventor of the percussion lock, Forsyth was born in 1769, graduated at King's College, Aberdeen, and from 1791 till his death was minister of his native place of Belhelvie. Devoting his spare time to chemistry and mechanics, in 1805 he brought out the percussion lock, which, though experimented with in the Tower of London, was not taken up by the Government. Forsyth refused an offer of 20,000*l*. from Napoleon for the secret.

June 13, 1847. David Mushet died.—A pioneer among modern metallurgists, Mushet began experimenting in the manufacture of iron and steel in 1793 while employed at the Clyde Iron Works. Dismissed through jealousy, he erected the Calder Iron Works, and while so engaged, in 1800 patented a process of making steel direct from iron in bars, and in 1801 made the discovery of the value of the black-band ironstone, which previously had been regarded as worthless.

June 14, 1768. James Short died.—In his day without a rival as a constructor of reflecting telescopes, Short was the first to give specula a true parabolic form. Born and educated at Edinburgh, where he learned mathematics from Maclaurin, he was summoned to London to give mathematical lessons to one of the royal family. He afterwards set up as an instrument maker in London.

June 14, 1874. Sir Charles Fox died.—Articled first to a doctor, Fox abandoned medicine for engineering, worked for Ericsson and Robert Stephenson, and became a partner in the firm of Fox, Henderson and Co., the first firm systematically to manufacture railway plant. Fox designed the buildings for the Great Exhibition of 1851, made the first narrow-gauge line in India, built the Berlin waterworks, and was connected with many railway enterprises.

June 15, 1905. James Mansergh died.—One of the greatest water-supply and sewerage engineers, Mansergh was responsible for works in some 60 or 70 towns at home and abroad. Among his most notable works were the Elan and Claerwen reservoirs in Wales, constructed for the Birmingham Corporation and opened by King Edward VII., July 21, 1904. In 1900 he served as President of the Institution of Civil Engineers.

June 15, 1915. Sir Nathaniel Barnaby died.—Barnaby came of a family of shipwrights, and was born at Chatham in 1829, the year the first British steam war-vessel was built. He was trained in the Royal Dockyard, and in 1870 succeeded Reed as Chief Constructor of the Navy, a post he held till 1885, when he was succeeded by White. To him were due many advances in the design and construction of warships; he introduced the use of steel, and during his regime sixty-six sea-going fighting ships of more than 2000 tons were built. The torpedo and torpedo boat came into use during his period of office, but he opposed the idea prevalent then, and periodically urged that the torpedo rendered the battleship obsolete.

E. C. S.

Societies and Academies.

LONDON.

Royal Society, May 25.—Sir Charles Sherrington, president, in the chair.—C. H. **Lees**: The thermal stresses in solid and in hollow circular cylinders concentrically heated. The method of calculation is similar to that used in dealing with spheres. Two cases of practical importance are worked out—that of a furnace with the temperature throughout the wall steady, and that of a pillar supporting the floor above a room in which a fire occurs. Curves are given for the thermal stresses produced.—B. F. J. **Schonland**: On the scattering of β-particles.—N. K. **Adam**: The properties and molecular structure of thin films. Pt. II. Condensed films. Pt. III. Expanded films. Saturated and unsaturated fatty acids of the long straight chain series, and their derivatives, including esters, substituted ureas, an alcohol, amide, and nitrite have been studied. Below a certain temperature determined by the conditions, the molecules appeared to be closely packed or "condensed." Above this temperature greater areas on the surface were occupied, such films being called "expanded films." Two general types of condensed film were found: one in which the hydrocarbon chains are close packed, while in the other probably only the polar groups touch. In the temperature interval (about 25° C.) between fully condensed and fully expanded states, pressure-area curves resemble isothermals of a vapour near critical temperature. Probably expanded films resemble vapours in two dimensions. Increase in length of hydrocarbon chains raises the temperature of expansion regularly. The lateral attraction which tends to keep the molecules close packed therefore depends on the length of these chains. Probably the greater attraction between longer chains diminishes the area of the expanded films. The area actually filled by molecules both of saturated and unsaturated acids is probably nearly the same in expanded and in condensed films; therefore it is unlikely that the unsaturated linkage in oleic acid approaches the water closely, as was previously thought.—E. **Wilson**: On the susceptibility of feebly magnetic bodies as affected by compression. Rock specimens were examined and the compressive stress was necessarily limited to about 1200 kgm. per sq. cm. Some feebly magnetic alloys have also been tested. All the specimens are in the form of short bars about 4 cm. in length, with a cross-section either 1 cm. square or 1 cm. in diameter, and the compressive stress has been applied in the direction of the length of the bar. The susceptibility has been measured (*a*) in the direction of the stress and (*b*) at right-angles to it.—S. F. **Grace**: Free motion of a sphere in a rotating liquid parallel to the axis of rotation. The motion is a small disturbance from one of uniform rotation, like a rigid body due to a projection, parallel to the axis of rotation, of a sphere of density equal to that of the liquid and originally at rest relative to it. The path of the centre of the sphere is a straight line, and the motion is symmetrical about it. The sphere oscillates about a point with amplitudes which diminish rapidly, being less than 0·02 of the velocity of projection, after one revolution of the liquid. The velocity of the liquid in this line is oscillatory. The disturbance over the plane through the centre of the sphere perpendicular to the axis is oscillatory, and confined to the immediate neighbourhood of the sphere. The components of verticity contain terms proportional to the time, so that the assumptions of small motion are ultimately violated.

Society of Glass Technology, May 17.—Prof. W. E. S. Turner, president, in the chair.—J. **Currie**: Columnar structure in sandstone blocks. A glass tank furnace sprang a leak in the bottom and the metal drained through rapidly. A full heat of 1300° C. was maintained to facilitate the removal of the metal, but finally part of the crown of the furnace collapsed and the gas was cut off. After the tank was dismantled it was observed that the sandstones readily disintegrated into long prismatic columns, many of which were straight, but most of them showing a decided curvature. They were roughly pentagonal in section, and varied in thickness from 0·5-1·5 inches; some were trigonal, others tetragonal in form. The columns were intersected at more or less regular intervals by cross joints, so that the sandstone tended to break up into short columns five or six inches long, some of which were regularly prismatic, others tapering off to a point. The effect is probably due to the rapid expansion caused by the sudden increase of temperature from 800° C. to 1300° C. resulting from the break in the furnace, followed by sudden cooling when the gas was turned off. The formation probably started at the point of contact with the glass, and as has already been claimed for similar formations in Nature, columnar jointing is related to the planes of cooling.—F. W. **Adams**: Some practical notes on the manufacture of white glass in a tank furnace. It is necessary to have complete analyses of all batch materials used, especially the selenium decoloriser. The total iron content in the finished glass must be kept constant, and careful weighing and efficient mixing of the batch ingredients is essential. Melting temperatures should be kept constant by the use of pyrometers. Lehr temperatures should be correct for a given type of glass and kept constant. Two pyrometer stations in the lehr are advisable, and articles differing greatly in weight should not be put together in the same lehr. Selenium offers many advantages over other decolorising media, and will undoubtedly be as generally used in this country for making colourless glass as in the United States when the conditions for its application are more fully understood by manufacturers.

Royal Meteorological Society, May 17.—Dr. C. Chree, president, in the chair.—A. E. M. **Geddes**: Weather and the crop-yield in the north-east counties of Scotland. The methods of correlation have been applied to find the relation between the yield of the crops in the three north-east counties of Scotland and the "weather," including in this term temperature and rainfall. There is not sufficient uniformity in all the conditions over the area from Nairn to Fife to permit of useful deductions being drawn. The final investigation was confined to the counties of Aberdeen, Banff, and Kincardine for the period 1885 to 1919. The conclusions are as follows: cereals do better in a comparatively warm summer with rainfall somewhat in excess; root crops show less connection with the weather than cereals, but are better with rainfall below the normal; hay is influenced almost as much by the weather of the year previous as by that of the actual year of harvest. Comparing the latest values for eastern England for the same period, it appears that the most important sections of the year, so far as weather is concerned, vary from district to district. It is important not to make the district too wide in such investigations.—H. P. **Waran**: A new form of direct-reading barometer. The instrument is a modified syphon barometer that compensates automatically for the change of level. This is accomplished by reading axially through the inclined upper reservoir, the reflection on the mercury surface of the divisions of a short length of vertically suspended scale, which has once been set to read the actual pressure, on the cross-wire.

PARIS.

Academy of Sciences, May 15.—M. Albin Haller in the chair.—L. **Maquenne** and R. **Cerighelli**: The influence of lime on the yield of seeds during the germinative period. Traces of lime in the culture fluid (10 parts of calcium sulphate per million) favour the growth of the organs, and this is shown not only by increased length, as compared with control seeds grown in distilled water, but also by increase in weight.—Georges **Charpy** and Louis **Grenet**: Study of the penetration of tempering in steel. A method is described permitting the study of the variation in hardness (Brinell) along a bar, after tempering at different temperatures, with or without reheating, and not necessitating test pieces being cut out of the specimen.—Gustave **Guillaumin**: The equations of the limit of equilibrium of adherent bodies.—Jean **Chazy**: The movement of a planet in a resisting medium.—F. **Michaud**: The rigidity of jellies. A new method of measuring the rigidity of a jelly is described, based on the use of a horizontal tube filled with the jelly and carrying some solid particles in suspension, the movement of which, when the ends of the rod of jelly are submitted to different pressures, can be measured in a microscope. The apparatus has been applied to the measurement of the rigidity of 15 solutions of gelose of concentrations varying from 0·4 to 6 per 1000. The experimental figures can be expressed by the empirical formula $\mu = 6{\cdot}32\ (c - 0{\cdot}39)^{3\cdot3}$, where μ is the modulus of rigidity in C.G.S. units, and c is the number of grams of gelose per 1000 grams of the mixture.—Henri **Abraham** and René **Planiol**: A new method of emission doubling the capacity of wireless telegraphy stations.—A. **Grebel**: A comburimeter and a controller for gas, Grebel-Velter system. In the "comburimètre," the coal gas is burnt in air, the ratio of gas to air being capable of variation and measurement. A mirror surface of fused lead serves as the indicator for oxygen in excess, and the exact quantity of air required for the complete combustion of a given volume of gas is thus continuously indicated.—Mme. **Ramart** and M. G. **Albesco**: Study of the two $\alpha\alpha\ .\ \beta\beta$-substituted propiophenones and their reaction with sodium amide.—Marcel **Delépine**: The auto-oxidation of organic sulphur compounds. A detailed account of some phenomena observed when air and certain sulphur compounds (such as $SC(OCH_3)(S\ .\ CH_3)$; $CH_3\ .\ CS\ .\ (OCH_3)$) interact. The observations cannot be fully explained.—Henri **Piéron**: The law of the velocity of establishment of the fundamental chromatic processes as a function of the intensity of the luminous stimulation.—Alphonse **Labbé**: The activation of the spermatozoid in heterogeneous fecundations.—Armand **Dehorne**: The formation of myolytic spindles and their phagocytosis in the cœlom of *Lipobranchus intermedius*. These organisms are extracted from old oyster shells by placing the latter in a crystallising basin filled with sea-water. The Lipobranchus can be seen swimming or attached to the sides of the basin. They are fixed living, and on microscopical analysis show marked phenomena of histolysis. It is remarkable that it is the muscles which show peculiar sensibility to this degeneration. The changes in the muscle fibres are described in detail.—C. **Gessard**: Varieties of pyocyanoid bacilli. The term "pyocyanoid" is applied to degenerate pyocyanic bacilli, which although retaining most of their original properties have lost the essential characteristic of making pyocyanine. One variety gives no trace of the blue colouring matter in peptone water or peptone gelose, but the pyocyanine reappears if a small quantity of glycerol be added to the peptone gelose. In cultures with increasing quantities of glycerol, the power of producing the blue pigment is lost.—Albert **Berthelot** and Mme. **St. Danysz-Michel**: The presence of acetone-producing micro-organisms in the intestinal flora of diabetics. Cultures from fæcal matter of 32 subjects, not diabetic, but suffering from various diseases, showed that no organism was present capable of producing acetone from starch. From similar cultures with fæces from diabetic patients, acetone-producing organisms were found in 17 cases out of 22. The view that diabetes is a disease of microbial origin is not in agreement with the present state of knowledge of this disease, but it is not altogether impossible that certain cases of diabetes may be caused, directly or indirectly, by the presence of certain micro-organisms in the intestine.—M. **Breton** and V. **Grysez**: The reactions of defence and immunity provoked by the intra-dermic injection of micro-organisms, either living or killed by heat. The skin of the rabbit possesses exceptional properties of defence against organisms inoculated there: immunity has been produced by a single injection.

Official Publications Received.

Annals of the Astronomical Observatory of Harvard College. Vol 86, Part 1: Observations and Investigations made at the Blue Hil Meteorological Observatory in the Year 1921 under the direction of Prof. A. McAdie. Pp. 61. (Cambridge, Mass.)

Egyptian Government. Almanac for the Year 1922. Pp. viii+242. (Cairo: Government Publications Office.) P.T. 10.

Dominion of New Zealand: Board of Science and Art. Bulletin No. 2: History of the Portobello Marine Fish-Hatchery and Biological Station. By the Hon. Geo. M. Thomson and the late T. Anderton. Pp. 131. (Wellington, N.Z.)

Annual Report of the Council of the Yorkshire Philosophical Society for the Year 1921, presented to the Annual Meeting, February 13th, 1922. Pp. 51. (York.)

The Royal Society for the Protection of Birds. Thirty-first Annual Report, January 1st to December 31st, 1921, with Proceedings of Annual Meeting, 1922. Pp. 76. (London: 23 Queen Anne's Gate, S.W.1.)

Diary of Societies.

FRIDAY, JUNE 9.

ROYAL SOCIETY OF MEDICINE (Electro-therapeutics Section) AND BRITISH ASSOCIATION FOR THE ADVANCEMENT OF RADIOLOGY AND PHYSIOTHERAPY (at 1 Wimpole Street), at 10.30 A.M. and 2.30.—Congress of Radiology and Physiotherapy.

PHYSICAL SOCIETY OF LONDON, at 3.30.—Visit to the National Physical Laboratory, Teddington.

ROYAL SOCIETY OF ARTS (Dominions and Colonies Section), at 4.30.—Major Sir Humphrey Leggett: Tanganyika Territory (formerly German East Africa).

ROYAL ASTRONOMICAL SOCIETY, at 5.

MALACOLOGICAL SOCIETY OF LONDON (at Linnean Society).

GEOLOGISTS' ASSOCIATION (at University College), at 7.30.—Dr. A. E. Trueman: The Liassic Rocks of Glamorgan.—C. C. Fagg: The Recession of the Chalk Escarpment and the Development of Valleys in the Chalk between the Mole and the Darenth.

ROYAL SOCIETY OF MEDICINE (Ophthalmology Section), at 8.30.—Annual General Meeting.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—J. Barcroft: Physiological Effects at High Altitudes in Peru.

SATURDAY, JUNE 10.

ROYAL SOCIETY OF MEDICINE (Electro-therapeutics Section) AND THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF RADIOLOGY AND PHYSIOTHERAPY (at 1 Wimpole Street), at 10 A.M. and 2.30.—Congress of Radiology and Physiotherapy.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir Hugh Allen: Early Keyboard Music (3).

MONDAY, JUNE 12.

VICTORIA INSTITUTE (at Central Buildings, Westminster), at 4.30.—Miss A. M. Hodgkin: The Witness of Archæology to the Bible.

INSTITUTE OF ACTUARIES, at 5.—Annual General Meeting.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.—General Meeting.

SOCIETY OF ENGINEERS (at Geological Society of London), at 5.30.—Dr. H. Chatley; A. S. E. Ackermann: The Physical Properties of Clay.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.—Business Meeting.

ARISTOTELIAN SOCIETY (at University of London Club, 21 Gower Street), at 8.—T. Greenwood: Geometry and Reality.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall, 135 New Bond Street), at 8.30.

ROYAL SOCIETY OF MEDICINE (Tropical Diseases and Parasitology Section), at 8.30.—Sir Leonard Rogers: Leprosy: its Etiology and Epidemiology.—D. Pinnock: Quinine Necrosis of Muscles.—Dr. J. Bamforth: Cortical Necrosis of the Kidney in a Fatal Case of Malaria.

TUESDAY, JUNE 13.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. G. Holmes: The Symptoms of Cerebellar Disease and their Interpretation (Croonian Lectures) (2).

ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—The Secretary: The Council's Scheme to establish an Aquarium in the Society's Gardens.—Miss Joan B. Proctor: A Study of the Tortoise *Testudo loveridgii*, Blgr., and the Morphogeny of the Chelonian Carapace.—J. T. Carter: A Microscopical Examination of the Teeth of the Primates.—H. G. Jackson: A Revision of the Isopod Genus Ligia (Fabricus).—W. R. B. Oliver: A Review of the Cetacea of the New Zealand Seas.—Prof. Wood Jones: The Dental Characters of certain Australian Rats.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—F. T. Usher: Matt Surface Plates.

QUEKETT MICROSCOPICAL CLUB, at 7.30.—E. K. Maxwell: Some Tubular Rotifers.—F. H. Davidson: Demonstration of Microscope and Super-Microscope.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—Prof. G. Elliot Smith and Prof. J. I. Hunter: A Reconstruction of the Piltdown Skull.

RÖNTGEN SOCIETY (at Institution of Electrical Engineers), at 8.15.—Dr. F. L. Hopwood and Dr. E. A. Owen: German Apparatus for the Production and Measurement of X-rays for Deep Therapy.—Prof. S. Russ and L. H. Clark: A Balance Method of Measuring X-rays for Therapeutic Purposes.—Dr. F. L. Hopwood: The Ondoscope.—Dr. E. A. Owen: The Sphere Gap Voltmeter.

SOCIOLOGICAL SOCIETY (at Royal Society), at 8.15.—G. K. Chesterton: The Return of the Guilds.

WEDNESDAY, JUNE 14.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—Prof. P. G. H. Boswell: The Petrography of the Cretaceous and Tertiary Outliers of the West of England.—Prof. W. N. Benson and Dr. S. Smith: Some Rugose Corals from the Burindi Series (Lower Carboniferous) of New South Wales.

ROYAL MICROSCOPICAL SOCIETY, at 8.—J. Strachan: The Microscope in Paper Making.—A. Chaston Chapman: The Use of the Microscope in the Brewing Industry.

THURSDAY, JUNE 15.

ROYAL SOCIETY, at 4.30.—*Probable Papers.*—Dr. H. M. Evans: The Defensive Spines of Fishes, Living and Fossil, and the Glandular Construction in connection therewith, and Observations on the Nature of Fish Venoms.—D. W. Cutler, L. M. Crump, and H. Sandon: A Quantitative Investigation of the Bacterial and Protozoan Population of the Soil: with an Account of the Protozoan Fauna.—D. W. Devanesen: The Development of the Calcareous Parts of the Lantern of Aristotle in *Echinus miliaris*.—Dr. A. Lipschütz, C. Wagner, R. Tamm, and F. Bormann: Further Experimental Investigations on the Hypertrophy of the Sexual Glands.

LINNEAN SOCIETY OF LONDON, at 5.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. G. Holmes: The Symptoms of Cerebellar Disease and their Interpretation (Croonian Lectures) (3).

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 5.30.—Lieut.-Col. A. Ogilvie: Some Aspects of Aeronautical Research (Wilbur Wright Lecture).

NATIONAL UNION OF SCIENTIFIC WORKERS (in Botanical Theatre, University College), at 5.30.—F. W. Sanderson: The Duty and Service of Science in the New Era.

CHEMICAL SOCIETY, at 8.—C. K. Ingold and E. A. Perren: Ring-chain Tautomerism. Part III. The Occurrence of Tautomerism of the Three-carbon (Glutaconic) Type between a Homocyclic Compound and its Unsaturated Open-chain Isomeride.

PUBLIC LECTURES.

(*A number in brackets indicates the number of a lecture in a series.*)

FRIDAY, JUNE 9.

UNIVERSITY COLLEGE, at 5.30.—Prof. E. Husserl: Phänomenologische Methode und Phänomenologische Philosophie (3). (In German.)

MONDAY, JUNE 12.

ROYAL SOCIETY OF MEDICINE, at 5.—Dr. M. Jansen: Injurious Agents and Growth. (In English.)

UNIVERSITY COLLEGE, at 5.30.—Prof. E. Husserl: Phänomenologische Methode und Phänomenologische Philosophie (4). (In German.)

TUESDAY, JUNE 13.

FELLOWSHIP OF MEDICINE (at 1 Wimpole Street), at 5.—Sir William Hale White: The Clinical Symptoms of Coli Infection of the Urine.

KING'S COLLEGE, at 5.30.—C. E. M. Joad: Vitalism Restated (2). Dualism and the Life Force.

THURSDAY, JUNE 15.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 5.—Prof. C. H. Reilly: Some London Streets and their Recent Buildings.

ST. MARY'S HOSPITAL (Institute of Pathology and Research), at 5.—Sir Berkeley G. A. Moynihan: Divertic ula of the Alimentary Tract.