NATURE

SATURDAY, MARCH 3, 1923.

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Editorial and Publishing Offices :
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Advertisements and business letters should be addressed to the Publishers.
Editorial communications to the Editor.

NO. 2783, VOL. 111]

Sequence in School Geometry.

THERE is discontent as to the condition of geometry teaching in schools, and in the search for remedies the question has been reopened whether there should be an "agreed" sequence. It appears from the report summarised in NATURE of February 24, p. 271, that 90 per cent. of those members of the Assistant Masters' Association who replied to a questionnaire voted for such a sequence, but there is the significant note, "The figures cannot be more than approximately correct, as some of the replies were difficult to interpret." It may be worth while to consider the question itself: what is meant by a "sequence"; for, unless we are clear about this, the question is ambiguous, and discussion, to say nothing about voting, may be wide of the mark.

Fifty, forty, even thirty years ago the pathway through school (and even college) mathematics was beset with the notice "Verboten." A boy might not use algebra in doing arithmetic; analysis was forbidden in geometry papers; calculus in doing analytical geometry or mechanics; while to mention a sine or cosine in the natural philosophy paper of a certain examining body would have been to pull the very whiskers of death.

Such, at least, were the facts as understood by those still *in statu pupillari* and as impressed upon them by their immediate teachers, whatever liberty the higher powers—the examiners—may have exercised in practice. But, above all, there must be no departure from the order of Euclid, and to use a later proposition in the proof of an earlier was mortal sin.

Now, here a distinction should be made: in part Euclid's order is essential to his general argument; but in part it is not and is merely matter of chance or convenience. For example, I. 16 (that the exterior angle of a triangle is greater than either of the interior opposite angles) of necessity comes before I. 32 (that the exterior angle is equal to the two together); and to use the latter to prove the former is a real error, betraying want of grasp of Euclid's argument.

On the other hand, his Sixth Book (on proportion and similar figures) does not depend on any proposition subsequent to I. 36 and I. 38 (that parallelograms and triangles on equal bases and between the same parallels are equal). Consequently, to use VI. 8 to prove I. 47 would not have been false logic, or an essential departure from his system, but merely a variation from the particular method he chose to adopt.

By sequence, then, we may mean either essential sequence, departure from which destroys the validity of the argument, or merely the arrangement of the subject-matter in an order dictated by convenience

or taste, not by logic. Now, what is in the mind of those who desire a uniform sequence, whether agreed or imposed? We do not know; but it may be useful to consider the case for both kinds of sequence—that of logic and that of convenience. We will take the latter first.

It would, no doubt, be convenient, as boys frequently move from school to school, if all followed the same general order—taking, for example, the circle before similarity or vice versa. But agreement on an open question like this is unlikely, for each of the equally admissible orders would find strong advocates, and teachers keenly interested in their work would not willingly surrender their liberty.

The graver question, of course, is as to the logical sequence. But in fact, the current practice of schools has eliminated the question in this form; for the practice is now widespread (and the Assistant Masters' Association's Report will give it further currency) of beginning the formal study of geometry at a point where a sufficiently broad quasi-axiomatic basis has been established, namely, the conditions of congruency of triangles and the angle properties of parallel lines.

This means in effect the abandonment, or at least the postponement, of most of Euclid's propositions up to I. 32. Experience has shown that many of these individual propositions are not really grasped by the ordinary boy, and if these are omitted others become unnecessary, as they are mere links between the others. The advantage of the omission is that a boy can begin where the work is easy instead of where it is most difficult.

Two questions of great importance emerge, however, and it is probably to these that those who are, quite justly, dissatisfied with the present state of things should address themselves. First, how can we recover anything that we have lost by departure from the strict traditional system; and second, when, if at all, should boys be introduced to the initial difficulties which have been evaded?

As to the former, it is suggested that the proper guiding word is not "sequence," but "interconnexion"—that the idea required is not so much that of a single thread, as of a network of argument. It is an excellent practice to take a known proposition and trace its connexions backward. Thus the property of a cyclic quadrilateral depends on the relation between the angle at the centre and that at the circumference; this, again, depends on two early propositions, namely, the exterior angle of a triangle is equal to the two interior angles, and the angles at the base of an isosceles triangle are equal; the former depends on the angle properties of parallels, the latter on congruence. Following this process, wherever we begin, we always get back to one or both of these fundamental principles.

This illustration shows how grasp of sequence can be strengthened; as illustration of interconnexion take Pythagoras's proposition. It may be proved, as in Euclid, by use of parallelograms and congruent triangles; or by variants, using parallelograms only, which, however, depend on congruent triangles; but again it may be proved by the use of similar triangles (Euclid VI. 8). But similar triangles rest on the angle properties of parallels and on Euclid VI. 2, or the equivalent proposition as to the segments made on transversals by parallels, and this, again, depends on congruence. Similarly, it seems unwise to neglect either of the proofs of Euclid III. 35, 36 (rectangles contained by segments of chords); the proof by similarity is the easier and shows the inwardness of the proposition better; Euclid's proof brings out the important fact that the rectangle is equal to $k^2 - r^2$, the "power of the point." Illustrations might be multiplied; but these will suffice to indicate what is meant, the habit of tracing connexions which gives mastery of the whole, and, it may be added, greatly increased power in what, after all, is the essential thing, the art of doing riders.

The second question does not, perhaps, as yet admit of so definite an answer: when and how far should pupils be asked to face the initial difficulties—congruence, parallelism, and the link propositions (*e.g.* inequalities) necessary for dealing with them? A partial answer may be given with some confidence: not until they have mastered the rest of the work and have gained power in solving problems. Beyond this it is not safe to dogmatise, but if geometry is worth studying for its own sake, for its beauty and essential interest, and not merely as an exercise in logic, it is quite possible, and, indeed, for most boys probable, that they will gain more by going on—by studying the ordinary developments not contained in Euclid, *e.g.* coaxal circles, pole and polar, inversion, etc., and geometrical conics, to say nothing of solid geometry—than by going back to examine first principles. Still in sixth form work, possibly in favourable circumstances in a fifth form, time might well be found for this; properly handled it would arouse great interest and would certainly be well within the power of the boys—as it is not within that of a third form. It involves, above all, the parallels axiom and some consideration of the relationship between axioms and definitions; in fact, it is quite as much a philosophic as a mathematical question. Its treatment would be rendered more effective by some knowledge of non-Euclidean geometry on the part of the teacher.

The Development of the Quantum Theory.

(1) *Molecular Physics*. By Dr. James Arnold Crowther. (Text-books of Chemical Research and Engineering.) Third edition. Pp. viii+189. (London: J. and A. Churchill, 1923.) 7*s*. 6*d*. net.

(2) *The Quantum Theory*. By Prof. Fritz Reiche. Translated by Dr. H. S. Hatfield and Henry L. Brose. Pp. v+183. (London: Methuen and Co., Ltd., 1922.) 6*s*. net.

TO give an intelligible account of the modern theory of "quanta" is a difficult, if not an impossible, task. Many of the ideas involved are unfamiliar, and between them and the laws of orthodox physics lies an unbridged gulf. Our sympathy must therefore be extended to the authors of the two volumes under consideration in the attempts they have made to explain and elucidate the theory. Dr. Crowther has added an interesting chapter of an elementary character on quanta to his book on molecular physics, and although his treatment is, perhaps necessarily, somewhat didactic he has succeeded in bringing out clearly the difficulties to be faced and the method of meeting them. "The merit of Planck's theory is not so much that it removes our troubles altogether, but that it packs them all together into one bag, so to speak, so that they become easier to handle." Prof. Reiche has given an exceptionally lucid exposition of the origin and development of the quantum theory, and the translation of his book, which appears to have been carefully carried out, may be recommended to English-speaking students of the subject. It is to be regretted that the bad example of the German original has been followed in collecting together indiscriminately mathematical notes and references to the number of 325 in an appendix of more than fifty pages.

The birth of the quantum theory was December 14, 1900, when Dr. Max Planck, professor of theoretical physics in the University of Berlin, made a communication to the German Physical Society on the distribution of energy in the normal or "black body" spectrum. He described a new method of obtaining the formula (which he had announced a few weeks earlier), representing the way in which the energy is divided between the various frequencies which go to form the complete continuous spectrum of the radiation. In order to secure agreement with experimental results Planck was led to the hypothesis of energy quanta, according to which the radiation energy of any assigned frequency ν can be emitted and absorbed only as an integral multiple of an element of energy $\epsilon=h\nu$, where h is a constant of Nature, now known as Planck's constant. The numerical value first given by Planck was $h=6{\cdot}55\times10^{-27}$ erg. sec., a value which is in remarkably good agreement with later determinations by several widely different methods. The fundamental relation of Planck's theory may be written in the form $\epsilon/\nu=nh$, where n is a positive integer. Thus h is a quantity of the dimensions of energy multiplied by time, that is of "Action" as that term is used in connexion with the Principle of Least Action, and the universal constant h represents a true *atom* of Action. Jeans remarks that "an attempt to imagine a universe in which action is atomic leads the mind into a state of hopeless confusion." Perhaps the attempt would be less bewildering were it possible to visualise more clearly the four-dimensional space-time world of Minkowski, in which action rather than energy is conserved. An element of this world may be regarded as an element of action.

In dealing with the radiation problem an incandescent body may be pictured as containing a large number of small oscillators, or Hertzian resonators, which are capable of acquiring energy and emitting radiation. In the first form of Planck's theory the fundamental hypothesis was that each resonator can acquire or lose energy only by sudden jumps, in such a way that its store of energy must always be an integral multiple of the quantum $h\nu$. Thus a resonator of high frequency can avail itself of energy only in large units, while a resonator of low frequency can absorb or emit energy in small quantities. It is not difficult to see that consequently the radiation will contain comparatively little light either of very short or of very long wave-length. There must be some intermediate value of the frequency corresponding to *maximum* emission of radiation, as is actually found to be the case in experiments on the distribution of energy in the spectrum of a "black body." By combining this conception of energy elements with Boltzmann's definition of entropy, Planck arrived at his celebrated radiation formula, which is found to agree closely with the results of observation. To minimise the difficulties associated with the discontinuous emission and absorption of radiation, Planck put forward modified forms of his theory later on, but many writers, including Poincaré, prefer the more drastic treatment originally proposed.

The failure at low temperatures of the law of Dulong and Petit, which assigns a constant value to the product of atomic weight and specific heat of a solid, may be explained if we abandon here, as we have already done in dealing with radiation, the principle of the equipartition of energy and make use, in some form or other, of the idea of a quantum. Einstein in 1907 was the first to attempt to solve this problem by applying the unitary theory of energy to the vibrational energy of the atoms of a solid. A more com-

plete and satisfactory theory was put forward in 1912 by Debye, who, instead of assuming a definite frequency characteristic of a particular substance, imagined the solid capable of vibrating so as to yield a whole spectrum of frequencies from zero up to an assigned maximum. Still better agreement with experiment was secured by a modification of Debye's theory proposed by Born and Kármán. Prof. Reiche gives an excellent account of this theory, which regards the solid not as a continuous elastic substance, but as an arrangement of atoms in a space lattice.

Perhaps the most startling application of the quantum theory is found in the remarkable connexion between moving electrons and electromagnetic waves. When light of sufficiently short wave-length is allowed to fall upon a polished metal plate, negative electrons are set free with a velocity v which depends upon the frequency ν of the exciting light. The maximum kinetic energy of an electron ($\frac{1}{2}mv^2$) increases with frequency in agreement with a formula first suggested by Einstein on the basis of the hypothesis of "light quanta." This fundamental law of photo-electric activity may be written

$$\tfrac{1}{2}mv^2 = h(\nu - \nu_0),$$

where ν_0 is a definite frequency characteristic of the metal on which the radiation falls. The equation possesses a very high degree of generality, for it applies not only to ordinary light, but also to X-rays, and appears to be valid not only in the case of emission of electrons under the influence of light, but also when emission of radiation is brought about in consequence of the impact of electrons. The extraordinary problem involved in this reciprocal relation has been well put by Sir William Bragg: "It is as if one dropped a plank into the sea from a height of 100 ft., and found that the spreading ripple was able, after travelling 1000 miles and becoming infinitesimal in comparison with its original amount, to act upon a wooden ship in such a way that a plank of that ship flew out of its place to a height of 100 ft. How does the energy get from one place to another?" "In many ways the transference of energy suggests the return to Newton's corpuscular theory. But the wave theory is too firmly established to be displaced from the ground that it occupies. We are obliged to use each theory as occasion demands, and to wait for further knowledge as to how it may be possible that both should be true at the same time."

The quantum theory of spectral series, with which the name of the Danish physicist Niels Bohr will always be associated, is based on two fundamental ideas. The first is a natural extension of the principle involved in the photo-electric effect. Bohr argued that when an atom emits monochromatic radiation of frequency ν, it must be because the atomic system has lost energy of amount $h\nu$. But a second application of the quantum principle is required in order to fix the "stationary states" of the atomic system, that is, to determine the *permissible* orbits. By the application of these hypotheses Bohr was brilliantly successful in deducing Balmer's and certain similar series emitted by hydrogen, and the series in the enhanced spectrum of helium.

The later and more general formulation of the quantum theory put forward by Wilson, Sommerfeld, Ishiwara, and others, has linked together the various interpretations given for the quantum constant, and has made further progress possible in different directions. Sommerfeld, taking into account the dependence of the mass of the electron upon its velocity, has been able to explain and even to predict the fine structure of the lines in the simpler series, and has obtained results of great interest in connexion with X-ray spectra. Much light has also been thrown by the theory on the resolution of spectral lines under the influence of an electric or a magnetic field.

Attempts have been made with a certain measure of success to apply the quantum theory to explain the facts of magnetism, and the existence of discrete tubes of magnetic induction of strength h/e (where e is the electron charge) has been suggested. To meet the demands of the principle of relativity it may be necessary to postulate discrete electromagnetic tubes, or "calamoids," in four dimensions. Theoretically there is much to be said for the introduction of the "magneton," as one of the ultimate constituents of atomic structure. Here we are brought face to face with one of the outstanding problems of physics. Is the atom a solar system in miniature in which electrons are in rapid orbital motion about a massive nucleus, or is it possible to employ stationary electrons or magnetons to give an approximately statical model? The quantum mechanism imagined by E. T. Whittaker may yield an answer to this question. Then what are we to say as to the bearing of the quantum theory on the still more difficult question of the structure of the nucleus itself!

Prof. Reiche heads his last chapter "The Future," and propounds a series of questions still awaiting solution. "That there are discrete mechanical and electrical systems, characterised by quantum conditions and marked out from the infinite continuity of 'classically' possible states, appears certain. But where does the deeper cause lie which brings about this discontinuity in nature? . . . Is radiation really propagated in the manner claimed by the classical theory, or has it also a quantum character? Over

all these problems there hovers at the present time a mysterious obscurity. In spite of the enormous empirical and theoretical material which lies before us, the flame of thought which shall illumine the obscurity is still wanting. Let us hope that the day is not far distant when the mighty labours of our generation will be brought to a successful conclusion."

H. S. ALLEN.

History of Medicine.

(1) *The School of Salernum: Regimen Sanitatis Salernitanum.* The English Version, by Sir John Harington. History of the School of Salernum, by Dr. Francis R. Packard, and a Note on the Prehistory of the Regimen Sanitatis, by Dr. Fielding H. Garrison. Pp. 216. (London: Oxford University Press, 1922.) 14*s.* net.

(2) *Life and Times of Ambroise Paré* (1510–1590): *With a New Translation of his Apology and an Account of his Journeys in Divers Places.* By Dr. F. R. Packard. Pp. xii+297. (London: Oxford University Press, 1922.) 28*s.* net.

(3) *The Gold-Headed Cane.* By Dr. W. Macmichael. New edition. Pp. xxvii+261. (London: Oxford University Press, n.d.) 16*s.* net.

THE growing interest in the study of the history of medicine to which the recent congress held in London testified (see NATURE, August 26, 1922, p. 296), is further exemplified by the publication of these three fine volumes from the Oxford University Press under the editorship of Dr. Francis S. Packard, editor of "The Annals of Medical History." All the works in question are classics, and perusal of them forms an attractive introduction to the study of medical history, illustrating as they do the development of medicine at different periods.

(1) The "Regimen Sanitatis Salernitanum" is a handbook of domestic medicine written in verse for the benefit of laymen and particularly for Robert, Duke of Normandy, the eldest son of William the Conqueror, who on his way to the Holy Land passed a winter at Salerno in 1096. He visited it again on his return from the Crusades in 1099, to seek relief, it is said, for a poisoned wound of the arm which he had received in the war. As Dr. Garrison points out in an introductory note, in the 14th and 15th centuries there was a veritable flood of hygienic rules addressed to great lords and ladies for their use in travel, campaigns, or pregnancy, all dealing with dietetics, oral hygiene, care of the hair, sleep, etc. The authorship of the "Regimen" is doubtful. Although Daremberg, who published the most complete modern edition in 1830, regarded it as the work of several hands, it is generally attributed to John of Milan, who was head of the School of Salerno at the end of the 11th century. The text of the various copies in existence differs considerably in length. Thus the text annotated by Arnold of Villa Nova (1235–1311), which is used in the present edition, contains 363 lines, whereas some manuscript editions contain less, and others more than a thousand lines. The translation in this edition is that published in 1607 by Sir John Harington, a well-known scholar and courtier of the time of Queen Elizabeth, under the title of "The Englishmans Doctor or The Schoole of Salerne or Physicall Observations for the perfect Preserving of the Body of Man in Continuall Health." The English text is accompanied by notes and embellished by curious illustrations taken from old editions of the "Regimen." A list of the more readily accessible works dealing with the School of Salerno is appended.

(2) The volume dealing with Ambroise Paré will by many readers be found to be the most attractive of the three books under notice. It contains not only a translation in which the spirit of the original is well preserved, of one of Paré's most remarkable writings, but also an admirable sketch of the period in which he lived, including an account of the Faculté de Médecine, the Confrérie de Saint Côme, and the community of barber surgeons, as well as a chronological description of Paré's works. The "Apologie et traite contenant les voyages faits en divers lieux," of which Dr. Packard offers a new and complete translation, was written in answer to a book published in 1580 by Etienne Gourmelen, dean of the Faculté de Médecine, who attacked Paré for his treatment of wounds and his use of the ligature. After showing that he had been preceded in the use of the ligature by a host of great authorities, including Hippocrates, Galen, Avicenna, Guy de Chauliac, Vesalius, Jean de Vigo, and others, Paré relates the histories of cases in which he had applied the method with success. The rest of the work consists of a description of the campaigns in Italy, France, Germany, and Flanders in which Paré took part, and of those whom "he dressed and God cured." The book is copiously illustrated, there being 27 full page plates, 22 text illustrations, and two folded maps of Paris of the 16th and 17th centuries.

(3) A cane in previous centuries was the appanage of every physician, and was usually crowned with a hollow knob of gold, silver, or ivory containing aromatic substances to keep off contagion. The gold-headed cane which has given its name to this volume had a crutch-shaped handle. The book consists of the supposed narration of a gold-headed cane which originally belonged to Radcliffe, and passed successively into the hands of Mead, Askew, Pitcairn, and Baillie, whose

professional careers it describes. On the death of Baillie, whom Sir William Osler regarded as in many ways the most distinguished possessor of the cane, his widow gave it to Sir Henry Halford, who presented it to the Royal College of Physicians, in the library of which it now reposes.

The memoirs of the cane give a vivid account of the social and professional life of the leading London physicians in the seventeenth and eighteenth centuries, including descriptions of the early meetings of the Royal Society. Of special interest is the life of Dr. Mead, of whom it is said that "of all physicians he gained the most, spent the most, and enjoyed the highest fame not only in his own but in foreign countries." Apart from their professional attainments, Mead and Askew were highly accomplished scholars and ardent bibliophiles, the extent of their acquisitions being shown by the fact that the sale of Mead's library took twenty-eight days and that of the *Bibliotheca Askeviana* twenty days. The real author of "The Gold-Headed Cane" was Dr., afterwards Sir William Macmichael, censor to the College of Physicians on two occasions and subsequently physician-in-ordinary to the King. Macmichael also wrote a small and entertaining volume entitled "Lives of British Physicians." The first edition of "The Gold-Headed Cane" was published in 1827, two years after the opening of the present home of the Royal College of Physicians in Pall Mall, and the second edition appeared the following year. A third edition was published in 1884, or forty-five years after Macmichael's death, by Dr. William Munk, registrar of the College, who continued the narrative down to 1871.

Frontier Tribes of Assam.

The Lhota Nagas. By J. P. Mills. With an Introduction and Supplementary Notes by J. H. Hutton. (Published by direction of the Government of Assam.) Pp. xxxix+255. (London: Macmillan and Co., Ltd., 1922.) 25*s.* net.

MR. MILLS'S monograph on the Lhota Nagas is a worthy supplement to the accounts of the Angami and Sema branches of the Naga tribes published by the enterprise and liberality of the Government of Assam, and written by Mr. J. H. Hutton, who has contributed a valuable introduction and notes to the present work. The volume contains a full description, pressed down and running over, of the life of this interesting people, who are now losing their identity by the influence of Christian and Hindu propaganda. A pleasant feature in the writer's work is the sympathy he shows for this childlike people, fully reciprocated by them, who showed their loyalty in the great war and claim to have defeated the Germans under the leadership of their white chief.

The most important part of the book is the introduction, in which Mr. Hutton, with unrivalled knowledge, sums up the latest conclusions on the ethnography of the Nagas. It gives a final blow to the methods pursued by the late Sir H. Risley and his school in dealing with the problems of Indian ethnology. Risley assumed that groups like Brahmans and Rajputs were homogeneous entities, and that it was possible by the measurement of a few skulls, collected haphazard, to

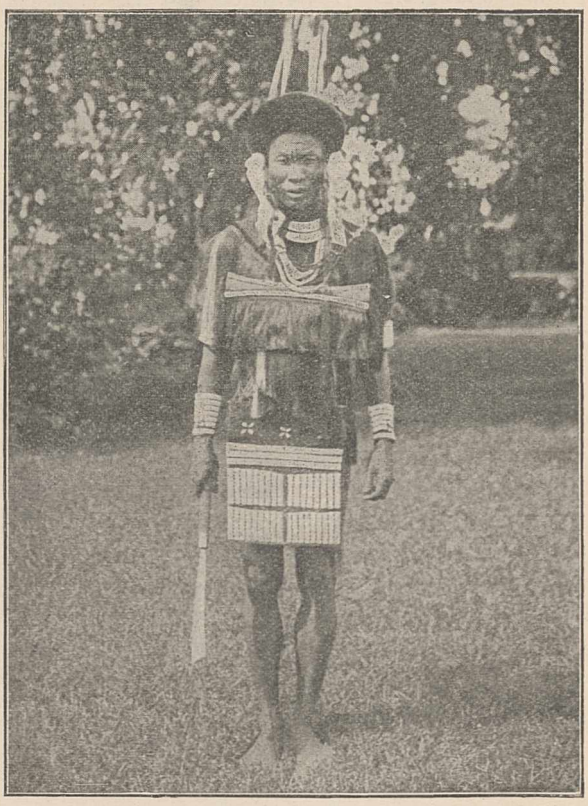

FIG. 1.—A Lhota warrior in full dress. From "The Lhota Nagas."

decide their position in his ethnological scheme. It has now been proved that these groups are in no sense homogeneous, and Mr. Hutton shows that the Naga tribes represent the convergence and assimilation of at least three streams of immigrants. "No Naga tribe is of pure blood, but the area which they inhabit has been the scene of immigrations from north-east, north-west, and south, and the different stocks introduced in this way have entered into their composition. Indeed, in view of the struggles that have taken place for the fertile plains of Burma to the east and India to the west, it is inevitable that some elements worsted in these struggles should have been pushed up into the hills." This is good sense and well expressed, and there is now no justification for accepting a hasty, ill-

considered generalisation, or for assuming the division of the Indian races into a series of water-tight compartments, a view contradicted by the whole course of Indian history.

Among the elements which contribute to the formation of the Naga group of tribes must now be recognised the Negrito, because Mr. Hutton has detected among them examples of a type "with a decidedly dark-brown skin and fuzzy hair." But it is to the Mon-Khmer races, deriving their origin ultimately from China and later from Burma, that we must look for the main constituents of the Naga

FIG. 2.—A medicine man (*Ratsen*) in a fit. From "The Lhota Nagas."

type. Mr. Hutton is possibly pushing the evidence a little too far when he suggests a comparison between a form of spear with ornamental barbs curving outwards from the shaft, a peculiar dao knife, and a shouldered hoe, with similar weapons and implements used by the Igorots of the Philippine Islands, as proving the common origin of these races. The general conclusion is quite acceptable, but it will need much further exploration to bring to light that amount of material by which so wide a generalisation can be established. But Mr. Hutton, who writes in a scholarly way and without any trace of dogmatism, is clearly working on scientific lines, and his admirable introduction throws much-needed light on the connexion of the races of eastern India with those of the Malay Peninsula and the islands farther east. It thus marks a decided advance towards the settlement of some of the most urgent problems of Indian ethnology.

Mr. Mills's work is an excellent example of field-work in ethnology, and it only remains to say that his monograph is furnished with a fine series of photographs, maps, and an admirable index compiled by Lieut.-Col. J. Shakespear.

Our Bookshelf.

An Introduction to the Chemistry of Plant Products. By Dr. Paul Haas and T. G. Hill. Vol. 2: Metabolic Processes. Pp. viii + 140. (London: Longmans, Green and Co., 1922.) 7*s.* 6*d.* net.

THE first volume of this work is already well known to students of plant physiology; first issued in 1912, it is already in its third edition. In this third edition the more physiological problems were left for treatment in this second volume, which is in effect a completely new book. In the brief preface the authors describe their choice between the alternative methods of treatment, and every student will be grateful for their courageous decision to attempt a connected account of the present state of our knowledge rather than an encyclopædic digest of the literature. The result is a book much more open to criticism but infinitely more valuable.

After a brief introductory section, devoted mainly to modern methods of measuring and expressing hydrion concentration, the synthetic metabolism of fats, carbohydrates and proteins is briefly considered, and two long chapters dealing respectively with respiration and growth conclude a short but exceedingly suggestive volume.

In the reviewer's opinion, the authors have done a great service to botany by their clear, concise and eminently readable treatment of their subject. The brevity of the section devoted to fats probably adequately reflects our ignorance of their metabolism in the plant, though one would have liked to see reference to the recent investigations of Neuberg and his collaborators. The section on photosynthesis forms an admirable complement to the monograph upon carbon assimilation by Jorgensen and Stiles, which considers the same problems from a more physical point of view.

The treatment of protein metabolism is somewhat scanty, again a correct reflection of our ignorance, but an introduction to the recent work upon the relation of hydrion concentration to the chemical and physical behaviour of the amphoteric protein would have been very valuable for the English reader. The emphasis given to the dehydrase mechanism in the treatment of respiration seems to the reviewer entirely sound; until oxidase mechanisms can be proved more effective upon sugars, their significance as a general respiratory mechanism must remain under suspicion. The chapter

on growth is very clear and well balanced; it is probably too early to hope for a critical treatment of the metabolic machinery of growth—at present there is very little metabolism in this chapter.

Among the Head-hunters of Formosa. By Janet B. Montgomery McGovern. Pp. 220+plates. (London: T. Fisher Unwin, 1922.) 15*s.* net.

ALTHOUGH Mrs. McGovern's interesting account of the aborigines of Formosa is written for the general public rather than the scientific reader, it is welcome as a first instalment of the information she acquired during her two years' stay on the island. Our knowledge of these peoples is very defective, and the more detailed study which she promises will be awaited eagerly. In this book the author draws an attractive picture of a people of many virtues, notwithstanding their head-hunting proclivities. Their culture and social organisation are of considerable interest, not the least noteworthy feature being the existence of a matriarchate vested in priestesses. Their religion consists mainly in reverence for their ancestors, but among the Taiyals, whose mountainous country is subject to violent rain-storms, the rain-devil is naturally of much importance. They do not, however, propitiate him, but avert his unwelcome attentions by a ceremony in which the priestesses, armed with knives, engage in what is clearly a combat with the spirit.

The aboriginal tribes show no traces of totemism or exogamy, although the marriage of first cousins is strictly prohibited. Their language belongs to the Malayan family, and the author considers that the affinity to the Indonesian peoples, which has been suggested by other writers, is supported by the occurrence of the nose-flute and pile-dwellings among them. In this connexion it may be noted that the prominence of priestesses in religious ceremonies, the sacred character of certain jars, and the significance of birds as omens, find a close parallel in the customs of certain tribes of Borneo.

Bureau of Education, India. Occasional Report No. 9. The Planning and Fitting up of School Laboratories. By M. C. S. Anantapadmanabha Rau. Pp. vii+40+8+18 plates. (Calcutta: Government Printing Office, 1921.) 1.4 rupees.

WORKS upon the material requirements of laboratories are very few, and as this subject is growing in importance published information is always to be welcomed. The first sixteen pages of the report deal with the general planning and relation of rooms and the arrangement and characters of the fittings they contain. In the remarks on construction it is surprising to see "brick nogged" partitions recommended as light suspended walls; in this country it has become rare even to find such construction in re-modelling buildings. The author proceeds to describe the fittings in detail, and while he gives a valuable summary every one will not agree with all his recommendations; thus he suggests lead for the bottoms of fume cupboards, and that the gas jet operating the draught should be placed at the top of the ventilating shaft near the exit, which would usually be a very inconvenient location. The plates which occupy the greater part of the volume give a series of good diagrammatic figures of fitting and plans of rooms, showing how these are laid out. These drawings are fully dimensioned and should prove of service in designing, though here again some difference of opinion may arise on the use of details; for example, metal handles, indicated for bench drawers, seem open to question. These are small criticisms and the volume will undoubtedly prove of considerable service.

A Summer in Greenland. By Prof. A. C. Seward. Pp. xii+100+29 plates. (Cambridge: At the University Press, 1922.) 7*s.* net.

Two months in west Greenland, where he went to collect fossil and recent plants in the summer of 1921, taught Prof. Seward the fascination of polar regions. Every chapter of this charming little book shows that the country has cast its spell over him. He does not attempt to justify his publication, but no justification is necessary. The book is a welcome addition to the literature of polar regions, for very little on Greenland has appeared in English in recent years. The author deals mainly with the botany and geology of the country, but there are some notes on its people and history, and a number of excellent illustrations and two maps. In the comparison of Arctic and Antarctic floras a correction may be made. Prof. Seward is mistaken in saying that not a single flowering plant has been discovered within the Antarctic Circle. The grass *Deschampsia antarctica*, which he cites from lat. 62° S., where, by the way, a true Antarctic climate occurs, was found, along with *Colobanthus crassifolius*, in lat. 68° S. in the west coast of Graham Land by the French Antarctic expedition in 1909. Another small point may be noted. Thule, in lat. 76° 35′ N., on the west coast of Greenland, is not the most northerly settlement in existence. Even if the Eskimo camp of Etah in lat. 78° 20′ N. be passed over, there is the large Norwegian coal-mining settlement of Nyaalesund in King Bay, Spitsbergen, in lat. 78° 55′ N.

Stories from the Early World. By R. M. Fleming. Pp. 156+12 plates. (London: Benn Bros. Ltd., 1922.) 15*s.* net.

THE success which has attended Miss Fleming's book, "Ancient Tales from Many Lands," has encouraged her to publish a second collection of tales dealing with the early world. In an interesting summary of the conclusion Prof. H. J. Fleure tells us that folk tales "have as their basis the interest of men in one another's ways when even neighbour people had very distinct civilisations." These tales cover a wide area and represent various phases of ancient life. One from America illustrates life before the domestication of animals, but recent investigation shows that cultivation is in many regions as old as herding. Many stories indicate the beginnings of trade and the social value of craftsmanship in the earlier development of settled life. That of Crœsus suggests the conflict between farmer-fishery in the Ægean and the warrior tribes of Media. That of Bilkis, Queen of Sheba, shows the Hebrews from the point of view of Islam, but Miss Fleming might have given the incident when Solomon hears that the Queen's legs were hairy, and forces her to raise her skirts in passing over the glass floor of his palace, believed to be a river, one incident which has parallels from India, strangely omitted in this world-wide survey. But folk

tales must not be pressed too far as evidence of prehistoric or ancient life. They have wandered too much to be distinctive of special types of culture—what is permanent is the incident, which is combined in many ways according to the fancy of the story-teller. The book, as a whole, is interesting and suggestive, and supplies excellent reading for children.

Marine Works: a Practical Treatise for Maritime Engineers, Landowners, and Public Authorities. By E. Latham. Pp. xii + 174. (London: Crosby Lockwood and Son, 1922.) 16*s.* net.

THE scope of Mr. Latham's book is fairly wide, as may be seen from the following brief list of subjects treated: waves, maritime structures, tidal berths, pile-driving, marsh lands, coast defence, navigable rivers, scour and deep-water quays. There is also an appendix on legal aspects of maritime engineering. The treatment of these subjects is a little uneven. Some parts of the volume are detailed and contain much useful information, particularly in regard to unit cost prices of work actually carried out. Elsewhere, there is a superficiality a little out of keeping with the title of "Treatise." For example, in the first chapter the author states that "the theory of wave action is of little practical value," and dismisses the matter with some scanty reference to certain writers who would scarcely claim that their contributions to the literature of the subject are as weighty and authoritative as those by others whose names are ignored. This rather slighting allusion to theory is scarcely justified by the facts. There are other opinions and views expressed, to which exception might be taken, but apart therefrom, there is much that is useful as an addition to technical knowledge. The book is stated to be the outcome of sixteen years' professional practice, and as such should be of value to practical engineers.

(1) *Second Year College Chemistry.* Pp. xi + 311. 15*s.* net. (2) *Second Year College Chemistry: a Manual of Laboratory Exercises.* Pp. vii + 115. 7*s.* 6*d.* net. By Prof. W. H. Chapin. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1922.)

(1) PROF. CHAPIN'S book has, for English readers, a somewhat misleading title. It is not an elementary treatise on inorganic chemistry, but a clear and very interesting introduction to general and physical chemistry—"the general principles which are the framework of our science." The gas laws, atomic and molecular theories (including the periodic system, radioactivity and the structure of the atom), solutions, equilibrium, and electro-chemistry, are all reviewed from the modern point of view, and the result is a readable, accurate, and stimulating book for junior students in universities.

(2) This is a companion volume to the "Second Year College Chemistry." The experiments include an elementary course in practical physical chemistry, and some of them are new. Although the practical courses in English institutions are differently arranged, Prof. Chapin's book will be found useful by teachers in the physical chemistry laboratory, as well as by lecturers on this subject.

Secret Sects of Syria and the Lebanon: a Consideration of their Origin, Creeds, and Religious Ceremonies, and their Connection with and Influence upon Modern Freemasonry. By B. H. Springett. Pp. 351. (London: G. Allen and Unwin, Ltd., 1922.) 12*s.* 6*d.* net.

MR. SPRINGETT'S aim is to show that the rites of Freemasonry are derived from the mystic religions of the East. These, in turn, he holds, can be traced through the ancient religions of Egypt and Mesopotamia to the stellar and solar cults of prehistoric times. He attempts to prove his case by a statement of the esoteric beliefs to which initiates were introduced by a regular gradation in such early cults as the Eleusinian mysteries, Mithraism, Zoroastrianism, the doctrines of Pythagoras, the Gnostics, and the Manicheans, as well as in Mohammedanism and its various sects. He suggests that Freemasonry can be connected with these beliefs through the Knights Templar who, he holds, had probably adopted the tenets of the Manicheans and had been influenced to a considerable degree by the Ismæli, the followers of the Old Man of the Mountains, known to the medieval world as Assassins. It may be pointed out that in many cases our knowledge of these secret tenets is of doubtful accuracy, while the evidence against the Templars is of little value. Owing to the author's lack of archæological knowledge, many of his arguments will not bear critical examination, while they embody a number of errors in matter of detail.

Química Experimental. By Prof. Roman Galarza. I: Mineral. Curso de Química Científica, con los Principios Recientes de la Físico-Química, para Uso de las Escuelas Normales y Colegios Nacionales. Pp. 128. (Córdoba: Angel Alvarez, 1922.)

THE volume before us is an introductory treatise on a very original plan. There is a full account of laboratory arts, with many useful recipes and practical hints; a very interesting historical narrative, which embodies a good deal of material not usually met with; and a description of some of the common elements, including physical chemistry. The book would be found very interesting and useful by chemical students learning Spanish. There are some trifling errors: Newton "nacido en Voolsthospe," which reminds one of the English Alchemist "Germspreiser" [James Price] of Figuier.

More Beetles. By J. Henri Fabre. Translated by A. Teixeira de Mattos. Pp. viii + 322. (London: Hodder and Stoughton, Ltd., 1922.) 8*s.* 6*d.* net.

THIS is the fourth and last volume on beetles in the collected English edition of Fabre's entomological works. It is of special interest in containing the complete account of the habits of the dung-beetle *Minotaurus typhœus*, which, almost alone among insects, presents the phenomenon of the male collaborating for many weeks with the female in providing accommodation and provisioning the larder for the offspring. In several chapters Fabre's scorn of the theory of evolution is strongly in evidence, notwithstanding that he adduces numerous instances of exquisite adaptations of structures to the habits of individual species, and at least one of sexual selection.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor 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 Function of Mendelian Genes.

IN NATURE for January 20, p. 74, Prof. MacBride makes a statement which appears to me to rest upon a fallacy. Since this fallacy is not uncommon, and since it concerns a very fundamental problem, I feel that perhaps a discussion of it in these columns may serve a useful purpose.

Prof. MacBride, in the review referred to, writes as follows: "Prof. Reinke encounters the Mendelian 'gene' and in our opinion takes it far too seriously. . . . It is becoming every day clearer *that a 'gene' is not a definite unit of structure at all, but simply the measure of the amount of pathological damage which the hereditary substance has undergone.* [Italics in the original.] It is a measure, in a word, of the 'imperfection of regulation.'"

The fallacy involved is simply this—that Prof. MacBride is using the word "gene" as if it meant "mutant gene." A mutant gene is, strictly speaking, that portion of the hereditary constitution which is responsible for the characters of a mutation observed to arise in Nature or in the course of experiment. I take it, however, that Prof. MacBride is considering all definite variations which are inherited according to Mendel's laws, whether their origin was observed or no; this at any rate is now a legitimate extension, and I shall employ "mutant gene" to denote the altered portion of the hereditary constitution responsible for variations inherited in a Mendelian way.

Now in point of fact, as Morgan himself and other writers have taken great pains to point out, the discovery of each new Mendelising variation, of each new mutant gene, implies also the discovery of an allelomorphic "normal gene" responsible for the production of the "normal" structure and function of the part or parts affected by the mutation.

The work on Drosophila has completely proved that Mendelian genes are carried in the chromosomes. Prof. Bateson, for long sceptical on this point, finally conceded it last year after seeing the work of Morgan and his pupils at Columbia University, New York. Further, it has proved that within each chromosome the genes are arranged in a definite way; the observed facts are intelligible if we assume that the genes are arranged in a constant and linear order, while no satisfactory alternative hypothesis has been put forward.

In any case, the order is identical for all the homologous chromosomes of the species which are tested. A mutant gene, therefore, occupies a similar position in one particular chromosome to that which is occupied in the corresponding chromosome of the normal wild strain by an allelomorphic gene which has not mutated. The mutant differs from the non-mutant gene by some definite alteration, presumably of a chemical nature: the existence of series of multiple allelomorphs, together with other evidence, proves that a recessive gene is not a mere total absence of the something we call the dominant gene. That is to say, in the chromosomes of the normal wild-type animal or plant there exist a large number of genes or factors the chemical constitution of which cannot be altered without giving rise to "mutations." Some of these mutations are pathological; others (*pace* Prof. MacBride !) are not.[1]

[1] See *Science Progress* for 1921, where Prof. MacBride, in answer to two letters of mine, eventually admitted that not all were pathological. This question, however, does not concern the present argument at all.

But even if they were *all* pathological, this would not alter in the very slightest the fact that their non-mutant allelomorphs constitute an orderly series of discrete units distributed in heredity by the chromosome mechanism (*i.e.* according to the laws of Mendel as extended by later research), and *all* necessary for the *normal* development of the individuals of the species. Of course, if all mutations were pathological, Mendelian genes would have no significance for evolution. However, they would even so continue to have the most fundamental significance for normal heredity.

Perhaps my meaning may be made clearer by a brief example. In the wild house-mouse, each hair is black with a yellow band across it, the yellow and black blending to give an appearance of grey; grey of this type is technically called "agouti." Black mice are mutants in which the yellow band is absent; this condition is recessive to normal. Yellow mice, on the other hand, have the yellow pigment extending the whole length of the hair; and yellow is dominant to grey (agouti). It is also dominant to black. The three types of colour and their behaviour in crosses can only be explained if we suppose that there is a definite gene responsible for the production of yellow pigment, and that this exists in three separate states—a "strong" state when a great deal of the pigment is produced, a "medium" state in which a moderate amount is produced, and a "weak" or non-effective state in which no yellow pigment is formed at all. The gene in its medium state is responsible for the particular proportion of yellow which we see in the hair of wild house-mice. The three states are all allelomorphic to each other, the "normal" being a Mendelian recessive as against yellow, a Mendelian dominant as against black. It is impossible to escape from the idea of a discrete unit of definite composition helping to determine coat-colour in the normal animal, strictly comparable to the homologous units responsible for the two "mutations."

This example is also of service as regards the abnormality or otherwise of mutations and mutant genes. The alteration productive of all-yellow is decidedly pathological. Even a single dose of this gene leads to excessive fatness, and two doses cause death of the fœtus *in utero*. The recessive "black" gene, on the other hand, does not appear to be responsible for any pathological effects. What is more, there is no evidence against the view that this mutant black is strictly comparable to the black of melanistic mammals in Nature, and the similarity is so great that the onus of proof lies on those who would dispute this homology.

In any event, there are two quite distinct aspects of the gene question—the genetic or hereditary, and the evolutionary. Mutations in Mendelian genes may or may not have been responsible for variation which has played a part in evolution. This I do not propose to discuss here, except to say that I know from many conversations that Prof. MacBride's views are too sweeping for a number of zoologists. But as regards inheritance within the species, the Mendelian gene—once the fallacy of confusing "mutant gene" with "gene" is seen and avoided—is clearly and obviously of importance.

We are to-day in a position to make a calculation of the order of magnitude of the number of genes in the chromosomes of Drosophila. It is certainly more than 1000; probably more than 2000; certainly less than 20,000. The effects of alterations in more than 200 of these genes (*i.e.* mutations) have been observed and studied; there is no sign that the rapid stream of new-discovered genes is slackening. With such a number of genes responsible for keeping the development of a little fly in the straight and narrow path of normality,

there seems very little room or need for subsidiary mechanisms of heredity. The cytoplasm presumably has its functions in this regard; but the absence of accuracy in cytoplasmic division, together with the presence of this large battery of genes in the accurately divided chromosomes, make us sceptical as to its possessing *many* "heredity-determining" substances. Finally, there is no reason to doubt and a good deal of reason to believe that all higher animals and plants possess chromosomal gene-complexes similar in essentials of structure and working to that so thoroughly analysed in Drosophila.

JULIAN S. HUXLEY.

New College, Oxford,
February 4.

Age and Area and Natural Selection.

I AM not especially eager to defend Dr. Willis's theory of "Age and Area." My chief interest in Dr. Willis's views is that they agree with those of Dr. W. Bateson and myself in accepting and confirming the conclusion that the distinctions of species have as a rule nothing to do with adaptation, and therefore nothing to do with Natural Selection.

Dr. Clark states (NATURE, February 3, p. 150) that every systematic zoologist whom he knows believes in Darwin's theory. But I long ago became convinced that the knowledge of systematic zoology, however profound and however accurate, confers no right to, and affords no justification for, the expression of opinions on questions of evolution, or at least on the causes and processes of evolution. To form a judgment on such questions requires certainly knowledge and experience of systematic zoology, especially of its principles and of the species in some particular group or groups of animals, but it also requires a practical knowledge of modern researches in genetics, of cytology, of certain branches of physiology, and of the life and habits of some group or groups of animals.

At the present time zoologists are usually specialists, and each specialist gives forth conclusions about problems of evolution based almost exclusively on the phenomena of his own special study. Dr. Bateson believes that no facts are of any great importance except those of genetics, that is to say, of the behaviour of characters in experimental breeding, and pays little or no attention to the question of adaptation. Prof. MacBride, on the other hand, a specialist in embryology, asserts that the characters and mutations studied by geneticists are merely pathological, and that all natural varieties are distinguished by differences of adaptation, due presumably to the action of external conditions. Dr. Clark apparently believes that diagnostic characters are all adaptive and to be explained by Natural Selection.

Dr. Clark states that his own special group is that of echinoderms. I wonder whether he has studied the mode of life of the species and varieties of echinoderms in Nature, and if he could bring forward any evidence to show a correlation between specific differences and differences of habit and mode of life. Many of the older systematists, holding no brief for any theory, recognised (and I think correctly) that there is a general distinction between characters which show natural affinities and are therefore most important in classification, and adaptive characters which are related to habits and conditions. Natural Selection is a theory of the origin of adaptations, and in my judgment there is ample evidence that specific differences are not as a rule differences of adaptation. Therefore Natural Selection does not explain specific differences. It is recognised now that in the cultivation of animals and plants the marked and constant characters which distinguish races are not, as Darwin believed, the gradual result of continued selection, but are mutations which have arisen spontaneously in definite form, not by successive stages. Does any one believe now that the rose comb in fowls is the result of a series of stages due to artificial selection?

If Dr. Clark would do me the honour of reading my book "Hormones and Heredity," he would find these matters more fully discussed, and would perhaps understand better why I consider the theory of Natural Selection to be obsolete. That conclusion, of course, is not disproved by the fact that many naturalists still believe in the theory, in America and elsewhere. But there are specialists in evolution as well as in systematic zoology and in other branches, and I venture to say that few who have made a special and practical study of evolution and are well acquainted with recent progress in that study, have much faith in Natural Selection.

It is evidence which is important rather than opinions, and I would ask what evidence Dr. Clark can bring forward to prove the adaptive value of specific and other diagnostic characters in echinoderms. Personally I am not interested in the explanation of the origin of species, but in the origin of the particular characters which distinguish one species from another.

J. T. CUNNINGHAM.

University of London Club,
21 Gower Street, W.C.,
February 5.

The Value of e/m.

IT is quite customary, at the present time, to use as the most probable value of e/m that derived by Paschen from spectroscopic data, as given by equations (12) and (13), page 272, and (15) and (16), page 275, of Sommerfeld's "Atombau," third edition. Taking Paschen's own estimate of the error in R_{He} and R_H, we have a probable error in e/m of about 0·2 per cent. But I have shown by a more detailed consideration of all available data (*Physical Review*, 17, 589, 1921) that Paschen's estimate of error for R_H ($\pm 0{\cdot}06$) is certainly too small, and that the true probable error is nearer $\pm 0{\cdot}2$. The latter figure leads to an error of 0·5 per cent in e/m, and the Paschen data, combined with the best data on atomic weights (4·002 and 1·0077 for He and H) result in $e/m = 1{\cdot}768 \pm 0{\cdot}009$, where the error in R_H has alone been considered.

Paschen used older and less accurate values for the index of refraction of air, in his reduction to vacuum. With the new values Bell (*Philosophical Magazine*, 40, 489, 1920) has shown that the value of R_{He} is raised 0·17 to 109,722·31. Since the calculation of this constant is independent of any particular assumptions as to the relative intensity of fine structure components, it is probable that this revised value is quite trustworthy, and I shall assume Paschen's own estimate of error, $\pm 0{\cdot}04$. The calculation of R_H is much more uncertain. Using the original Sommerfeld theory, as Paschen did, but all available data and the newer values for the reduction to vacuum, I have shown (*loc. cit.*) that Paschen's value of R_H is raised 0·14, to 109,677·826. But experimental results agree more closely with the more rational Bohr theory as to the intensity relations, and this theory yields a value of R_H lower by 0·21. Any lowering of the 2 to 1 intensity ratio of the Balmer series components leads to a lower value of R_H. I have suggested 109,677·7 as the most probable value of R_H, this being the mean value yielded by various theories. This value, combined with Bell's revised value of R_{He} gives 1·762 for e/m.

Finally, the new data by Wood (*Philosophical Magazine*, 44, 538, 1922) on the extended Balmer series makes possible a new computation of R_H. I find that these new measurements are entirely consistent with the previous data, and yield 109,677·6, with an assumed intensity ratio of 5 to 4. (A 1 to 1 ratio lowers this result 0·08.) There seems to be no question that the two fine structure components, with the exception of H_α and H_β, are of nearly equal intensity. I am therefore inclined to consider 109,677·6 as a preferable value for R_H, and this yields 1·758 for e/m, a value for which the probable error is fully 0·5 per cent. The point I should like to emphasise is that the newer experimental results for hydrogen indicate that $R_{He} - R_H$ must have a larger value than that computed by Paschen, and hence e/m must be smaller, but that the probable error is much greater than that assumed by Paschen. I have previously (*Physical Review*, 14, 363, 1919) used 1·773 as the most probable value of e/m, and while this value may be slightly too large, I still feel that it is more trustworthy than the spectroscopic value of 1·758. Without a considerable advance in our experimental knowledge of the fine structure of the hydrogen lines, it is scarcely possible to diminish appreciably the uncertainty in this latter value. New experimental data on the value of e/m, derived from deflection experiments or from the Zeeman effect, are greatly to be desired.

RAYMOND T. BIRGE.

University of California,
January 11.

Sir Christopher Wren's Science Museum.

AT the present time, when the thoughts of all are being directed to the fifty churches and innumerable other buildings that are associated with the name of Wren, reference may appropriately be made in NATURE to his epoch-making work for science during the best twenty years of his life, to his scientific instruments, and to his Science Museum (Fig. 1). His instruments, after having been piously preserved for many years in the repository of the Royal Society at Gresham College, have now vanished, but his building, the Old Ashmolean Museum, is still standing, though no longer used for the purpose for which it was intended.

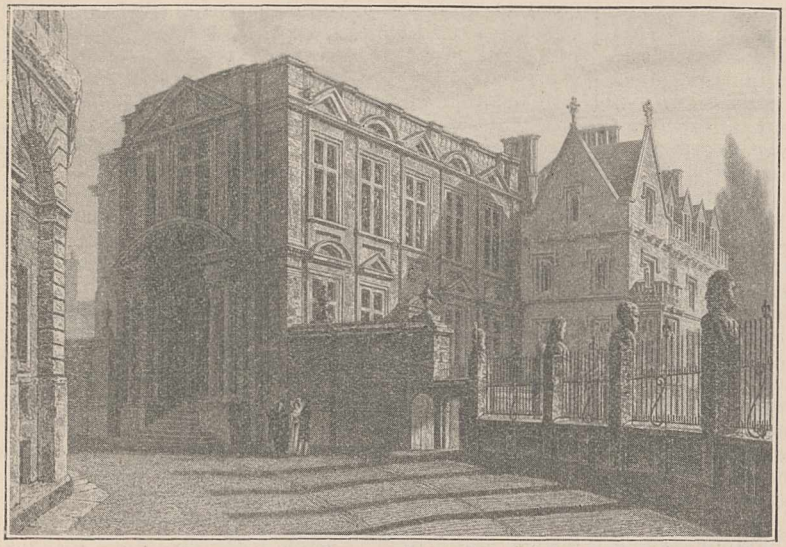

FIG. 1.—Wren's Science Museum at Oxford. (After Mackenzie and Le Keux, Memorials, 1834.)

Since the destruction in 1767 of Gresham College, the venerable seat of learning and science, where the original members of the Royal Society used to hold their meetings, no existing building is more closely associated with the spirit of the time of the foundation of that society than is the Old Ashmolean Museum.

On the occasion of the 300th anniversary of the birth of Ashmole, this building was described in NATURE of May 17, 1917, as our first public Museum of Natural History, and now, on the occasion of the bicentenary celebrations in honour of Sir Christopher Wren, we would emphasise the intimate connexion it has with the great architect, who owed much of his surpassing merit in the arts to the preliminary training that he had in Oxford as a man of science.

Elmes, in his "Life of Wren" (1823), attributes the Ashmolean Museum to him, but as some recent writers have cast a doubt upon the matter, I have examined all available materials, and have come to the conclusion that there is every reason for upholding the correctness of Elmes' attribution. According to the Vice-Chancellor's Accounts, the building of Dr. Ashmole's Repository took about four years (1679–83), during part of which time Wren was engaged on other important works in Oxford. It was erected only a few yards from the Sheldonian Theatre, his earlier work: a science museum would scarcely have been placed so near without having consulted Wren. There is no record of any fee having been paid to him, but he would have known that the University was barely able to meet the building expenses of the new Museum, and it is known that on occasions he gave his services free. As president of the Royal Society, and as builder of some half-dozen churches in London, he was fully occupied elsewhere during the construction; and the work of supervision was entrusted to Mr. Davis, the University Bailiff, who received 80*l.* for this service. Wood, the stone-cutter, received 1912*l.* 5*s.* 5*d.* for the masonry work, and the accounts of the carpenters, plaisterer, plumber, painter, and glazier were settled separately.

A finely designed portal, flanked by columns and opening under a richly ornamented canopy, leads into a large room running the whole length of the building, about 58 ft. 6 in. long by 24 ft. 10 in. wide. It is lit by five high windows on the north side. On the upper floor a similar room has been divided into two, which are perhaps the best lit rooms in Oxford, having large windows on three sides, N., S., and E. or W. It is necessary to emphasise this point, because a contrary statement, disparaging Wren's building, appeared in the *Times* for December 2, 1922. The windows are about 10 ft. high by 4 ft. 6 in. wide, and there are no dark corners anywhere.

The illustration printed with this letter shows the balustrade round the roof of the building. It is the counterpart of the contemporaneous work at Christ Church, and of the earlier work on the Sheldonian Theatre. Wren was very partial to balustrades. Moreover, it stands within the railing that was undoubtedly designed by him.

When recalling the connexion of the Museum with two of the first fellows of the Royal Society—Wren

and Ashmole—the link with the founder of the Society should not be forgotten; the monogram of Charles II.—"C. II."—is carved over the fine balcony window in the middle of the front of the building.

It is on account of these various associations with British science and the early days of the Royal Society that a petition has been laid before the Hebdomadal Council of Oxford, requesting that the vacant rooms in the old Museum may be once more used for the purposes of natural science for which they were built.

R. T. GUNTHER.

Magdalen College, Oxford.

Tesla Spectra of Complex Compounds.

IN NATURE of January 27, p. 115, a very interesting letter appeared by J. K. Marsh and A. W. Stewart on "Tesla Spectra and the Fraunhofer Effect in Complex Compounds."

More than a year ago I began an investigation of the band spectra of benzene vapour under the action of high-frequency discharges. Both the absorption and emission spectra were examined. Other more complicated substances were also tried in a state of vapour.

Upon varying the capacity, and more especially the self-induction, as well as altering the vapour pressure between wide limits, *emission* bands can very clearly be seen. Each substance has a characteristic spacing of the emission bands; they appear in a perfectly definite order. Nitrogen is a very good example of this.

In the case of benzene, I photographed a whole series of emission bands which lie very close to its absorption and fluorescence bands. I referred briefly to this in my article on "Spectres d'absorption et de fluorescence du benzene" (*Journal de Physique et le Radium*, Juin, 1922, p. 210).

J. K. Marsh and A. W. Stewart express the wish to reserve for themselves the further examination of Tesla spectra. I should only like to say here that we have been working for a long time on similar ground, but one thing is certain, that we have been working from entirely different points of view. Our principal object is to work out the structure, size and shape of the molecules from their band spectra.

Our investigations, and those of Messrs. Marsh and Stewart, should therefore be of mutual advantage one to the other.

The subject is so vast that the more it is investigated, the sooner will the question of the band spectra be solved.

VICTOR HENRI.

Institute of Physical Chemistry,
University of Zürich,
February 2.

WHEN our letter to NATURE of January 27 was written, we were under the impression that we were the only workers in this field, as the researches of Wiedemann, Eberts, and de Hemptinne in 1897 and earlier years had led to no results in the particular region which we were investigating. Prof. Henri has courteously sent us a private communication as well as the above letter, and has forwarded also a copy of the paper which he mentions. In this paper occurs the following sentence: "Nous avons entrepris une série de recherches pour étudier la fluorescence et la luminescence de la vapeur de benzène sous différentes conditions, en particulier sous l'influence de décharges électriques diverses." As was natural in the case of a long paper, this sentence was not reproduced in the abstract which appeared in the Chemical Society's Journal; and as we had no access to the *Journal de Physique et le Radium* itself, we were quite unaware that any one was working in the field. Thus our work and the unpublished results of Prof. Henri are entirely independent of each other; and we are anxious that the mere accident of our having been first in actual publication of detailed results should not in any way deprive Prof. Henri of his full share in the credit of the discovery and investigation of these new spectra.

As Prof. Henri says in his letter, the subject is being approached along two separate lines, as we are mainly interested in the relation between the chemical constitution of substances and the spectra produced by them, whereas he is working back from the spectra as a basis to the machinery which produces the spectra within the molecules and is investigating also the variations produced by different electric wave-lengths—a subject which we have no intention of entering upon now, since it is in his hands. Our lines of research therefore supplement each other; and we cordially agree with Prof. Henri that there is more than enough room for both our laboratories to work in this interesting new field. We should like to express our appreciation of the courtesy which Prof. Henri has shown in this matter.

J. K. MARSH,
A. W. STEWART.

The Sir Donald Currie Laboratories,
The Queen's University of Belfast,
February 8.

Calendar Reform.

DURING the 16th century Pope Gregory XIII. effected a very necessary rectification of the Julian Calendar, which was not, however, legally adopted in England till 1752. The effect of the correction was to bring forward the dates of the solstices from about the tenth to the twenty-first of June and December; but the climatic significance of this astronomical dislocation in the calendar was not serious, and the calendar months retained the same distinctive seasonal characters as heretofore. As, therefore, the present calendar is the same in essentials as that instituted by Julius and Augustus Cæsar some 2000 years ago, it must have come as a surprise, possibly a shock, to many readers of NATURE (December 2, p. 747) to learn that we may shortly be asked to suffer all the inconvenience and confusion of a catastrophic alteration in the calendar on grounds which seem altogether trivial. In the first place, the calendar months now in use have by long association become enshrined in literature as the very impersonation of definite stages in the seasonal progression and retrogression of natural phenomena, and it would be sheer vandalism to break this association, and renounce our literary heritage, without far graver practical cause than can possibly be shown.

In the second place, every calendar system must be framed with reference to the four natural landmarks of the year, namely, the solstices and equinoxes, and it is eminently desirable that the two solstices, and the two equinoxes, which stand opposite one another in the natural year, should not be assigned dates which are unsymmetrically disposed to one another. In the proposed system of 13 months, the solstices would stand 6½ months or time-units apart, instead of a whole number as in the present system, and no month would be located diametrically opposite another as at present, viz. December to June, March to September, and so on, along the earth's orbit round the sun. This arrangement would offend the artistic sense of any one with a vivid appreciation of the fact that our fundamental division of time, the year, is not an arbitrary unit but one based on a grand cycle of Nature.

Thirdly, it is said that meteorologists and astronomers would welcome months with equal numbers of days, and no doubt they would, one and all, if they could order everything to perfection. But apart from the labour that would be involved in preserving the continuity of the climatological record, involving the translation of one calendar into the other, think of the confusion that would arise in making comparisons between two systems which both have the same names of months! We should be perpetually having to think and specify whether it is the old *January* or the new *January* we are considering, and so forth. It would be just as though, when the new barometer unit the *millibar* was instituted to replace the *inch*, the name "inch" had been retained for the new division. Far better would it be to have an entirely new set of calendar names so that the old names would retain their habitual meanings. It is always open to astronomers and meteorologists to invent a system for any special technical purpose for which it may be required; but probably not many of them would take the narrow view and wish to disorganise the world on that account.

This country can, when it likes. be very much to the fore when issues of real importance are involved; but with a sane respect for tradition it is scarcely likely to countenance interference with a system of time-measurement the correction of which by Pope Gregory XIII. was designed to hold good for a very long period ahead. L. C. W. BONACINA.

27 Tanza Road, Hampstead, N.W.3.
January 27.

Time Relations in a Dream.

I WAS much interested by Dr. Atkins's letter in NATURE of January 27, p. 117, about time-rate in dreams, and more especially by what he says of the metallic nature of the sound as heard in the dream. This fits in with an observation I made a couple of years ago when I was in lodgings close to a bell-tower. It happened that for other reasons I was not sleeping well at the time, and was frequently waked by the bell ringing hours and quarters. It always seemed then of much higher pitch when I heard it in a dream, or even when I was just awake enough to recognise the source of sound, than when I was fully awake. Several times I could follow the same sound repeated during my transition from sleep to waking, and then found that I really heard the upper notes of the bell in their true pitch, the lower notes being completely blocked out.

Though I have since been able to verify this interpretation nearly to my own satisfaction, I should be glad if any one else could confirm it in any way, as, in the nature of the case, it is difficult to be certain of one's judgment. Can the physiopsychologists help towards an explanation, assuming I am right?

H. F. BIGGS.

The Electrical Laboratory,
Oxford, January 29.

The Ascent of Elvers in Egyptian Waters.

IN connexion with Dr. Schmidt's article on the "Breeding Places and Migrations of the Eel" (NATURE, January 13, p. 51), it may be of interest to give the results of further observations upon the arrival and ascent of elvers in Egyptian waters. The records were made at the pumping-station mentioned in Dr. Schmidt's article. The station is exceptionally favourable for such observation, since skilled observers were (and are) present day and night (in connexion with other fishery work) throughout the year. There can be no doubt, therefore, that when elvers were reported absent there were in fact none to be seen. Since the pumping-station ceases to work early in the summer, this fact may bring the ascent artificially to an end; but, as a rule, there are signs that the main run is over before the pumps stop. The numbers transported are given as an indication of the extent of the "runs."

All the early "runs" consist of transparent elvers; from the middle of April onwards about 50 per cent. are pigmented.

The observations are as follows:

1919–1920 Season: No observations prior to January 20, 1920, on which date transparent elvers were abundant and remained so until April 15, when the pumps stopped working. Reappeared in large numbers on the nights of July 2, 3, and 4. Total transported, 6,260,000.

1920–1921 Season: First observed December 15, 1920 (also on some date in Lake Menzaleh, near Port Said); remained few till January 30, when they appeared in large numbers for two nights only; then disappeared completely until April 7, when they were present for three successive nights. Appeared again April 19–May 24, when pumps ceased working. Total transported, 1,797,000.

1921–1922 Season: First observed on November 11, 1921, in small quantity till January 20, 1922; remained abundant till February 20, 1922; disappeared till March 23, continuing in decreasing numbers until April 10, when pumps stopped. Total transported, 2,484,000.

1922–1923 Season: First observed October 25; remained in small numbers until December 4, when they were abundant for two nights; remained few in number to date, January 24, 1923.

From the above, it may be observed:

(1) That elvers may make their first appearance at a given place nearly two months later in one year than another.

(2) That the dates of first appearance in Egypt are the same as those recorded for the West of Ireland, France, and Spain—say, 1500 miles nearer the suggested centre of dispersal in the Western Atlantic.

(3) That the main "runs" occur in the same months (February–April) in rivers as widely separated geographically as the Severn, the Po, and the Nile, notwithstanding the very different climatic conditions obtaining in these months in the last-named region.

G. W. PAGET.

Coastguards and Fisheries Service, Cairo.

Transcription of Russian Proper Names.

IN order to conclude the discussion which followed my proposal to use letters of the Czech alphabet for the above purpose (NATURE, April 29, 1922, p. 552)—a proposal which was opposed by Lord Gleichen and Mr. J. H. Reynolds and defended by Messrs. Druce and Glazunov (NATURE, November 11, p. 635, and October 14, p. 512)—I tried to find out the opinion of the Academy of Petrograd about this matter. At last, only recently, I have succeeded in obtaining from one member of the Russian Academy of Sciences a copy of a publication: "Memorial book of the Imperial Academy of Sciences for 1914—published March 20.—S.-Petĕrburg 1914." This contains on p. 180 a "Transcription of Russian Proper Names, approved by the Imperial Academy of Sciences (accepted in the Conference at the meeting of December 2/15, 1906)." To this table six notes are added containing rules concerning the cases in which

to use or not to use for transcriptions of vowels the Czech *j*, referred to in the table under (1)-(5).

а	б	в	г	д	е[2]	ё[5]	ж	з	и[3]	і	й
a	b	v	g	d	e, je	ë	ž	z	i, ji	i	j
к	л	м	н	о	п	р	с	т	у	ф	х	ц	ч
k	l	m	n	o	p	r	s	t	u	f	ch	c	č
ш	щ	ъ	ы	ь[4]	ѣ[2]	э	ю[1]	я[1]	о	v			
š	šč	–	y	ĭ	ě, jě	e	ju, ĭu	ja, ĭa	f	i			

For brevity's sake I do not translate the single notes.

I lived long enough in England to love the nation and appreciate its wonderful conservatism, and I quite understand that English geographers will scarcely give up the transcription once introduced by Lord Gleichen (of which I also possess a copy); yet a glance at the special Ordnance maps of countries of Central Europe, for example the excellent maps (1 : 75,000 or 1 : 25,000) of the late Austrian Empire, might convince everybody that the diacritic signs of half-a-dozen different languages are not a drawback in producing or using such maps even for military purposes.

Thus the nations outside Great Britain will have to choose between the mode of transcription defended by Lord Gleichen or the rules given by the Russian Academy of Sciences, which—up to this date having been unknown to me—happen to coincide with my proposal.

BOHUSLAV BRAUNER.
Bohemian University, Prague—VI.
February 1.

Herapath's Artificial Tourmalines.

I SEE that Prof. F. J. Cheshire (NATURE, February 3, p. 171), in his presidential address to the Royal Microscopical Society, urges "that the work of Herapath and others in the production of artificial tourmalines should be again taken up," and I wish strongly to support this hope. In my report in the War Office "Observations on Malaria" (1919) I showed that the Herapath test for quinine, especially as modified by Prof. W. Ramsden, is the most delicate test known for this alkaloid, and I feel certain that Herapath's method lends itself to many other applications. I have never found it to fail in the case of quinine, which I was able to detect even in dilutions of 1 in 15,000,000.

M. NIERENSTEIN.
University of Bristol,
February 6.

The Mechanism of Audition.

IN connexion with the recent discussion in NATURE of the mechanism of the cochlea, and of the model of the cochlea designed by Mr. George Wilkinson (October 21, p. 559; November 11, p. 632), it seems well to point out another characteristic of hearing which will have to be taken into account in any comprehensive theory of audition. This is the abruptness of the changes which are found in the sensitivity of many ears when tested as a function of frequency. These are disclosed by the accurate determinations of the sensitivity-frequency characteristics of ears which have been made possible by the use of continuous ranges of pitch for acuity tests instead of the method of tests at discrete frequencies which has usually been used. A description of the apparatus used is given in an article soon to appear in the *Physical Review*. In some cases with apparently normal hearing people, changes as great as a factor of one thousand in the necessary intensity for audition are found with a change of pitch of a semitone, these occurring in connexion with depressions in the general level of sensitivity. Pictorially, this would seem to require the physical existence of a large number of elements each of which is concerned with the transmission of only a very narrow range of frequencies, these differentiated elements existing in the inner ear, in a possible cable from the ear to the brain, in the brain itself, or possibly in all three places, and of such a nature that the individual elements may be quite severely injured without seriously affecting neighbouring elements.

FREDERICK W. KRANZ.
Riverbank Laboratories, Geneva, Illinois.

Spiranthes autumnalis.

IN NATURE of February 10, p. 185, Prof. Bower describes the finding of the orchid *Spiranthes autumnalis* near Carrbridge in the summer of 1921. I have to report the discovery of a single specimen of this orchid in the first week of September 1922, on Docharn Craig, a small hill (1250 ft.) four miles south-east of Carrbridge. The hill is under cultivation up to 1100 ft. on the southern side, but on the northern side there are the remains of a wood of magnificent wind-sown pines. The floor of the wood is covered with *Vaccinium* spp. (mainly *oxycoccus*), mixed in places with *Erica Tetralix* and *E. cinerea*: earlier in the season *Pyrola rotundifolia* and *Trientalis europea* were abundant. Only one plant of *Spiranthes autumnalis* was found, although the interest attaching to its unexpected discovery in this locality led to a careful search of the whole wood. The specimen was unfortunately lost in the transit to town, but when fresh it was quite unmistakable.

E. PHILIP SMITH.
46 Murrayfield Avenue,
Edinburgh, February 11.

PROF. BOWER'S letter in NATURE of February 10, recording the finding of *Spiranthus autumnalis* near Carrbridge, Inverness-shire, prompts me to record the presence of that orchid in the Island of Coll, Argyllshire.

Whilst surveying there in August 1921 my wife and I noted some half-dozen specimens. These, though undoubtedly of the genus Spiranthus, did not tally exactly with the description of *S. autumnalis* as given in Hooker's Flora, but the difference was not sufficient to make them a variety.

Unfortunately we have not preserved a specimen, but we were so surprised at the time at finding that species in Coll that we sent one specimen to a competent field botanist who confirmed our identification.

JOHN B. SIMPSON.
H.M. Geological Survey Office,
33 George Square, Edinburgh.

The Drayson Paradox.

THE writer of the first paragraph in the astronomical column of NATURE of January 20, page 94, refers to my pamphlet (Wm. Pollard and Co., Exeter, 1*s.* 6*d.*) in a way which might lead an incautious reader to suppose he had seen it, which evidently he has not, or he would scarcely speak of "wresting a few isolated observations to suit their preconceived views" in face of the statement on its nineteenth page that

"the *general consensus* of the stars supports the result given." A proof of that statement, a quantitative proof, will be found on pp. 42-44. I cannot encroach on your space to quote it here, but may briefly indicate its nature: P being the pole of the heavens and E the pole of the ecliptic, let P E C be a spherical triangle having E C 6°, P E 23° 27′, and P E C 174° 28′. Describe a small circle with C as centre and C P as radius: then will W, where E C produced cuts the circumference of the circle, be that spot where is situated the so-called "Apex of Solar Motion." The sides and angles given are not arbitrary but depend upon the rate of precession and of the decrease in the obliquity at the commencement of this century, as is shown on page 44 of the pamphlet.

This is a geometrical problem the significance of which your astronomical readers will readily appreciate. The facts it rests on are undeniable, and no alternative explanation to that suggested has hitherto been forthcoming.

A. H. BARLEY.

Leppington House,
Hertford.

MR. BARLEY'S "incautious reader" would be quite correct in supposing that I had not only "seen" his pamphlet but read it carefully. It is not my practice to review works that I have not seen. I have, indeed, followed Draysonian publications with a melancholy interest from my youth up, and I cannot but regard them as an example of ingenuity misapplied.

Mr. Barley in his letter does not touch on the points I made (1) that if the proper motions of stars were due to any shift of the earth's axis, all the stars in a given direction would move together, and there would be no relative shift among them. But in examining photographs of the regions round stars with sensible proper motions (say Capella) the P.M. star is clearly seen to be moving among the faint stars in the background at practically the same rate as that given by the meridian observations. Indeed, Prof. Furuhjelm was enabled to detect a very distant companion to Capella by its sharing in its rapid motion relatively to the neighbouring stars. What is it then but "wresting" evidence to deny the reality of Capella's motion. (2) Mr. Barley denies the fact that the ecliptic is moving among the stars, and quotes Drayson as having tried to establish from the observations of Hipparchus that such motion did not exist. This to me appears another flagrant example of wresting isolated observations.

Hipparchus's results were liable to errors of several minutes of arc, whereas modern results are accurate to a second or thereabouts. Hence we can get a better result from 50 years using modern observations, than from 2000 years using those of Hipparchus. The modern observations show unmistakably that the ecliptic is shifting. Of course it is impossible to give all the evidence for this in the course of a letter, but I have arranged a small number of observations in a way that will show an unbiassed reader that such is the case.

The following table gives the North Polar Distance of the star 1 Geminorum as observed at Greenwich in different years, and also the North Polar Distance of the sun interpolated for the moment that its Right Ascension was the same as that of the star. It is to be noted that the N.P.D. of the star is referred to the mean equator of the year, that of the sun to the apparent equator affected by nutation; we can correct for this approximately by combining observations made about nine years apart when the nutation is opposite in direction and amount.

NORTH POLAR DISTANCE

Year.	Star.	Sun.	Star South	Mean.
1836	66° 44′ 7·71″	66° 32′ 39·05″	11′ 28·66″	
1844	66 44 5·51	66 32 49·42	11 16·09	11′ 22·18″
1855	66 44 1·70	66 32 39·92	11 21·78	
1876	66 43 55·85	66 32 39·54	11 16·31	11 5·04
1885	66 43 54·99	66 33 1·23	10 53·76	
1902	66 43 51·90	66 33 2·57	10 49·33	10 54·79
1911	66 43 51·65	66 32 51·40	11 0·25	

It will be seen that in sixty-one years the sun's path has moved southward relatively to the star 27·4″. The star itself is moving south 10·8″ per century (Boss), so this has to be added to the southward movement of the ecliptic. It will be understood that I give these figures merely to demonstrate the reality of the movement of the ecliptic, not to determine its exact amount, for which further refinements would be necessary. I chose a star near the solstitial colure (1) because difference of N.P.D. practically agrees with difference of latitude, thus saving reduction; (2) because this is the neighbourhood where the ecliptic is moving south most rapidly. I reiterate my advice to Mr. Barley to study the whole of modern astronomy of position, instead of confining himself to a few selected portions, which he interprets in a way that further study would show to be untenable.

THE WRITER OF THE NOTE.

The Naming of Elements.

SURELY the time has come to abandon the practice of attaching to elements fancy names arbitrarily selected by individuals. When names concerned nobody but a small clique in constant personal communication, and when they had nothing more important to record about an element than the personality of its discoverer, there may have been something to say for the system. Nowadays neither condition is fulfilled. Thousands are interested who have no means of expressing their opinion: and there is something definitely scientific to be said about elements. The new element was discovered as a consequence of a theory of the structure of the atom, and its discoverers should surely be glad to see a record left in the name that their discovery was no lucky fluke.

Dr. Aston, who has discovered at least twice as many elements as anybody else in the history of science, has set a good example; he has waived his right of naming, undoubted under the old dispensation. He has left them unnamed until a consensus of scientific opinion has established a scientific system of nomenclature. Will not others follow his lead? Until its isotopic constitution is discovered, let us simply call the new element 72.

NORMAN R. CAMPBELL.

Sarsen Stones.

REFERRING to the note on the discovery of the above near Maidstone, which appeared in NATURE of February 10, p. 195, may I direct attention to the fact that they occur in considerable numbers of large size, often in groups, near Faversham. The botryoidal concretionary surface-feature is frequently present, but what appears to be of greater interest is that many of the blocks are perforated by long, tubular holes suggestive of the work of marine annelids anterior to the consolidation of the rock. The gravel pits in this district yield large masses of sarsen occasionally. One stone I found recently weighs more than 2½ cwt., and can now be seen at the Twickenham Public Library. Full particulars appeared in the local press (*Richmond and Twickenham Times*, December 23, 1922).

C. CARUS-WILSON.

Twickenham, February 19.

Poisoning by Illuminating Gas.

DURING the last few months much attention has been given in the public press to the question of the poisonous properties of illuminating gas and the risk to life which may be incurred if an escape of gas should take place in an ordinary dwelling. The only constituent of illuminating gas which has serious poisonous properties in this connexion is carbon monoxide.

Carbon monoxide has the property of forming a dissociable compound with the hæmoglobin of the blood just as has oxygen, but the affinity of carbon monoxide for hæmoglobin is about 240 times that of oxygen for hæmoglobin. The greater the extent to which the hæmoglobin becomes combined with carbon monoxide the less is its capacity to act as a carrier of oxygen between the lungs and the tissues of the body, and if sufficient of the hæmoglobin in the blood becomes combined with carbon monoxide the normal oxygen supply to the tissues must evidently be seriously affected. The effects produced by severe carbon monoxide poisoning are, in fact, those of slow or rapid asphyxiation.

If blood is exposed outside the body to air containing both oxygen and carbon monoxide the partition of the hæmoglobin between the two gases follows the laws of mass action, being determined by the relative partial pressure of the gases, allowance being made for the difference in their affinities. The air in the lungs with which the blood undergoes gaseous interchange contains in man about 14 per cent. of oxygen when he is breathing ordinary air. If human blood is saturated *in vitro* at body temperature with an atmosphere containing 14 per cent. of oxygen and $\frac{1}{240}$ of this proportion of carbon monoxide, *i.e.* 0·058 per cent., the hæmoglobin will finally become equally divided between the two gases, or 50 per cent. saturated with carbon monoxide and 50 per cent. with oxygen. If the concentration of oxygen is kept constant and that of carbon monoxide is varied the degree to which the hæmoglobin will become saturated with carbon monoxide is as follows :

IN THE PRESENCE OF 14 PER CENT. OF OXYGEN.

Percentage of carbon monoxide.	Approximate final percentage saturation of hæmoglobin with carbon monoxide.
0·015	20
0·03	33
0·06	50
0·12	67
0·17	75
0·23	80

If a person is exposed to ordinary air containing carbon monoxide the hæmoglobin in his blood will gradually become saturated with carbon monoxide just as in the experiments *in vitro*, and the degree of saturation will finally attain a steady value dependent on the precise concentration of carbon monoxide in the air that he is breathing. The symptoms that result will vary with the degree to which the hæmoglobin is saturated with carbon monoxide. If the hæmoglobin is 20 per cent. saturated the effects are practically unnoticeable to a normal healthy man, though headache may be caused by prolonged exposure or appear subsequently after reaching fresh air : even with 33 per cent. saturation nothing of a really serious nature occurs, though nausea and headache may be felt after some time, and transitory giddiness and confusion will occur after any short and severe muscular exertion. As the saturation of the hæmoglobin with carbon monoxide gets higher the symptoms rapidly become serious. With 50 per cent. saturation, giddiness, weakness and inco-ordination of muscular movement, failure of mental power, and diminution of acuity of vision and hearing are pronounced ; slight muscular exertion causes palpitation of the heart and undue breathlessness, and will probably result in partial or complete loss of consciousness for a time. Such a degree of saturation must therefore be regarded as definitely disabling, but, so far as is known, it will not prove fatal. If the affected person is removed to pure air the mass influence of the oxygen will gradually expel the carbon monoxide from the blood, and the more urgent symptoms will subside fairly rapidly, though nausea, severe headache, and malaise may persist for many hours. With still higher saturations complete paralysis and unconsciousness will supervene, and the end may come with a painless death from sheer failure of the oxygen supply to the tissues of the body.

The minimum concentration of carbon monoxide that will prove fatal is not known with certainty, but the available evidence points to the conclusion that death will ensue after an exposure for several hours to air containing 0·2 per cent. of the gas. Much depends on the length of time that the blood has been highly saturated with carbon monoxide, for the longer grave shortage of oxygen is maintained the more serious is the damage to the tissues of the body, particularly to the nervous system, and the more difficult is recovery. Bearing this in mind it is not improbable that 0·15 per cent. of carbon monoxide in the air breathed might prove dangerous to life in the case of prolonged exposures.

Exposure to relatively high concentrations of the gas leads, of course, to rapid loss of consciousness and death, but in accidental cases of poisoning the concentration of carbon monoxide is, as a rule, comparatively low, and in these circumstances the onset of symptoms will be gradual though progressive, for the gas owing to its low concentration will diffuse but slowly into the blood and it will be long before complete gaseous equilibrium can be established between the blood and the air in the lungs. Herein lies a great danger, for so insidious is the onset of the symptoms that the person affected may not realise that anything is amiss until he has lost so much power in his limbs as to render it impossible to withdraw from the danger. With 0·1 per cent. of carbon monoxide in the air breathed a resting person will become disabled in about two hours and a half, with 0·2 per cent. in little more than a hour, and with 0·4 per cent. in about half an hour. The acceleration of the respiration and circulation by muscular exercise will greatly hasten the rate at which carbon monoxide is absorbed into the blood.

At present there is no legal limitation of the amount of carbon monoxide that may be supplied in ordinary

illuminating gas. The Departmental Committee on the Manufacture and Use of Water Gas, 1899, recommended that the Board of Trade should have the power to limit the proportion of carbon monoxide in illuminating gas to 12 per cent. or such higher value as should be considered safe. This recommendation was not, however, made statutory. The Departmental Committee on Carbon Monoxide, 1921, reported "that it is not necessary or desirable to prescribe any limitations of the proportion of carbon monoxide which may be supplied in gas used for domestic purposes," though a suggestion was considered that a limit of 20 per cent. of carbon monoxide might be imposed. Pure coal gas contains 6-8 per cent. of carbon monoxide, water gas contains about 40 per cent., and carburetted water gas about 30 per cent. Water gas is often added for economic reasons to pure coal gas, and the illuminating gas supplied to the public not infrequently contains a quite considerable proportion of carbon monoxide. Occasionally so much as 50 per cent. of water gas has been mixed with the coal gas, with the result that the illuminating gas has contained 20 per cent., or slightly more, of carbon monoxide. As a rule, however, the proportion of water gas is considerably lower than this, and some companies still continue to supply pure coal gas.

An escape of gas is likely to be noticed and quickly remedied during the daytime, but far greater danger arises at night when a person may fall asleep in an ill-ventilated bedroom without noticing that the tap of a gas jet has been accidentally left turned on, or disregarding as trivial an escape of gas from some faulty fitting. He may then be disabled before he has any warning of the danger, and when once disabled he may not be found till many hours have elapsed and it is too late to save him. From the experimental data recorded by Dr. J. S. Haldane in the report of the Water Gas Committee it is possible to calculate the concentration of carbon monoxide which will finally be attained in a room if there is a leak of gas into it, making the assumption that the carbon monoxide becomes uniformly mixed with the air. Even in the most unfavourable circumstances, when there are no special openings to admit of ventilation, there is always a considerable interchange of air through the walls, roof, and floor of any room. Even if the outside air is quite still a volume of fresh air equal to the cubic contents of the room will gain admission in 1·8 hours in a room of 500 cubic feet, in 2·3 hours in one of 1000 cubic feet, and in 2·9 hours in one of 2000 cubic feet, and these rates may be doubled if a strong wind is blowing or if the room is furnished with a fireplace the chimney of which is not blocked. Taking the most unfavourable case the following table shows what will happen in three different-sized rooms if there is a leakage of gas into these rooms at the rates respectively of 4 and 10 cubic feet per hour :

Capacity of room in cubic feet.	Carbon monoxide percentage eventually reached in the room when the illuminating gas contains the following percentages of carbon monoxide.				
	A. Leak of 4 Cubic Feet per Hour.				
	5%.	10%.	15%.	20%.	30%.
500	0·07	0·14	0·22	0·29	0·43
1000	0·05	0·09	0·14	0·18	0·28
2000	0·03	0·06	0·09	0·12	0·17
	B. Leak of 10 Cubic Feet per Hour.				
	5%.	10%.	15%.	20%.	30%.
500	0·18	0·36	0·54	0·72	1·04
1000	0·12	0·23	0·34	0·46	0·69
2000	0·07	0·15	0·22	0·29	0·43

The dotted lines mark the division into fatal and non-fatal percentages of carbon monoxide on the assumption that a concentration of 0·2 per cent. of carbon monoxide may prove fatal if maintained for several hours.

On testing the rate of escape of gas from an unlit gas-jet when the tap was turned on fully, four different burners chosen at random gave the following results. Under a gas pressure of 4 inches of water a properly regulated universal type of incandescent burner with inverted mantle passed about 4 cubic feet of gas per hour, and a Bijou burner of the same type about half that quantity. Under pressures of 1½ and 3 inches of water a No. 3 Bray flat flame burner passed about 6 cubic feet and 9 cubic feet per hour, respectively, and a No. 5 Bray burner about 8 and 11 cubic feet. Under the most adverse conditions, therefore, the risk of fatal poisoning would appear not to be very great in the case of escape from a single well-regulated incandescent burner so long as the proportion of carbon monoxide in the illuminating gas does not exceed 20 per cent., save in rooms of very small cubic capacity, though temporary severe symptoms might be caused. The real danger evidently lies in a leakage of gas considerably greater than that which might be obtained from such a burner. The pressure under which gas is supplied differs very greatly in different localities (under the Gas Regulation Act a minimum pressure of 2 inches water gauge has now to be maintained in the gas mains during the night), and an ordinary flat flame burner through which the rate of escape of gas will vary roughly as the square root of the pressure may clearly become a source of considerable danger if the tap should be accidentally turned full on. Some flat flame burners of improved type allow, however, much less gas to escape than the figures given above. Still greater risk attaches naturally to the grosser forms of leakage from unlit gas-rings, fractured pipes, accidentally disconnected unions and the like, provided that the escaping gas becomes sufficiently mixed with the air in the room. The Water Gas Committee found that with a large escape of coal gas the gas might collect mainly at the top of the room, and if the air in the room remained undisturbed it might be long before feeble convection currents could establish a fatal atmosphere at the level of a bed, but the case is, of course, quite different when the gas is rich in carbon monoxide.

It must be remembered that the table above intentionally depicts the most disadvantageous conditions for the occupant of the room. The majority of bedrooms possess a fireplace, and windows and doors often do not shut very tightly. The natural ventilation in a room might easily be double that on which the table is based without any special provision for ventilation, and the figures shown would then be halved. Under such conditions it would probably require a leak into a room of 1000 cubic feet capacity of 10 cubic feet per hour of gas containing 15 per cent.

of carbon monoxide to establish in the end a really dangerous atmosphere. That the risk in any case is bound to become far greater as the proportion of carbon monoxide in the illuminating gas is increased is evident. In the U.S.A., where much greater concentrations of water gas are used than in this country —indeed pure carburetted water gas is often supplied —the death rate from both accidental and suicidal gas poisoning appears to be far higher than in England. An article in a recent number of the *American Gas Association Monthly* conveys the impression that the gas companies are fully alive to the dangerous qualities of the gas that they distribute, for one of the New York Companies is stated to maintain in each of the districts it supplies a motor van with three crews working in eight-hour shifts ready to do ordinary repairs, and to proceed at any hour of the day or night when a case of gas poisoning is reported, not only to rectify the fault but also to resuscitate the victim of carbon monoxide if he can be reached in time, the crews having been specially trained for this purpose.

It is no use belittling the risks incurred by increasing the proportion of carbon monoxide in illuminating gas, but they should not be unduly exaggerated. It is evidently a case for striking a reasonable balance between the risk and the economic advantages of cheap light and heat for domestic purposes. The risk of accidental poisoning is greater the smaller the room in which an escape of gas occurs. The steady improvement in the housing of the poorer classes, the general use of more economical burners, such as incandescent burners, and the more widespread knowledge of the fact that illuminating gas does have poisonous properties undoubtedly justify a higher limit to be set to the concentration of carbon monoxide permissible in illuminating gas than was contemplated by the Water Gas Committee in 1899, but it may very reasonably be questioned whether the recommendation of the Carbon Monoxide Committee in 1921, that no limitation at all should be imposed by statute, is really justifiable. The report of the latter committee is certainly a most unconvincing document.

Imperial College of Science and Technology.

OPENING OF THE NEW BOTANY BUILDING (PLANT TECHNOLOGY).

THE Imperial College of Science and Technology was founded to give advanced training not only in pure science but also in science in relation to industry. The close association of pure and applied science is exemplified in all the departments of the College, and under the direction of Prof. J. B. Farmer the botany department has been not the least conspicuous in the development of pure botany and of the various branches of applied botany which may be grouped together as plant technology. The department has for a number of years specialised in training men as economic botanists, and particularly for work in the great plantation industries of the tropics, such as rubber, cotton, sugar, etc. Ravages of disease caused by fungal and insect pests, and by other injurious agencies not yet so clearly defined, are particularly severe in these tropical industries, and without the control that science can supply their prosperity would be slight. A considerable proportion of the officers who are engaged in combating disease in tropical plantations have received their scientific training at the Imperial College.

By the rapid expansion of the work of the department in the direction of plant physiology, plant pathology, bacteriology, biochemistry, and plant technology generally, the accommodation provided by the present botany building became quite inadequate, though it was opened only so recently as 1914. Accordingly, an appeal for contributions towards the cost of an additional building was made to the members of the Rubber Growers' Association by Mr. Herbert Wright, an old student of the department and now chairman of the executive committee of the governing body of the College. Thanks to Mr. Wright's untiring zeal and energy and to his personal generosity, the magnificent sum of 30,000*l.* was raised.

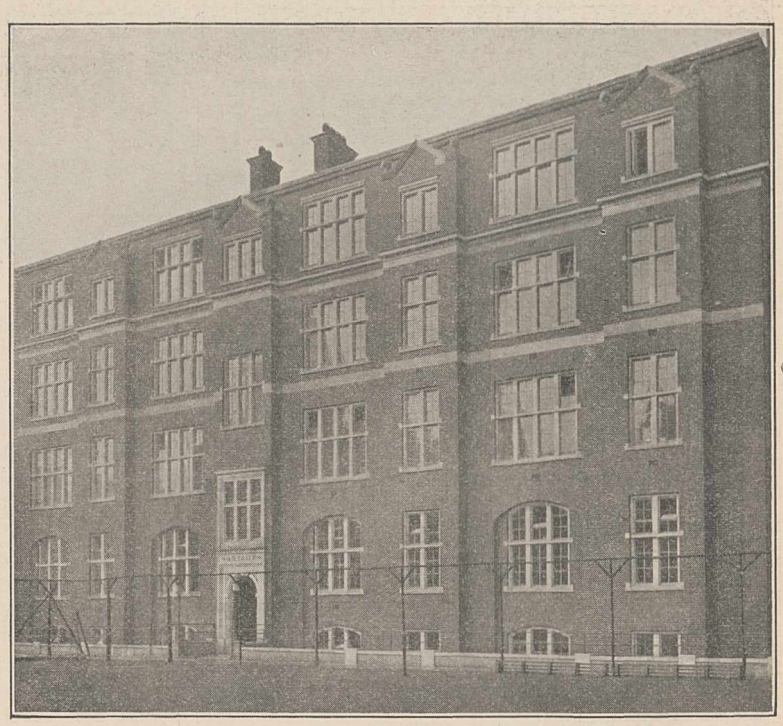

FIG. 1.—New botany (plant technology) building, Imperial College of Science and Technology.

The new building was designed by Sir Aston Webb, and is a substantial and well-planned structure of five floors. The basement and ground floors are allocated

to biochemistry, and the first floor to the bacteriological side of plant pathology. The biochemical department is well fitted for modern work in biochemistry and includes, besides a laboratory for ordinary class instruction, a large and lofty general laboratory, a number of special research laboratories and private rooms, a laboratory for physical work, a balance room, and a machine room with grinding mills, presses, vacuum distillation apparatus, etc. The bacteriological laboratories are not only fitted for cultural work in microbiology, but also for chemical work in relation to fermentation by yeasts, moulds, and bacteria. On the first floor there is also to be a permanent rubber museum dealing especially with the diseases to which Hevea is subject.

The new building was opened on the afternoon of February 16. The ceremony was performed by the Duke of Devonshire, Secretary of State for the Colonies, Lord Buckmaster (chairman of the governing body) being in the chair. Mr. Herbert Wright, in an introductory speech, explained that the development of the department was due to the foresight and genius of Prof. Farmer, who many years ago realised how much could be done for the development of tropical industry by men with a proper training in such branches of botany as plant pathology and plant physiology. The response to the appeal to the Rubber Growers' Association was so encouraging because the members knew that the College had year after year trained men qualified to advise on vital problems relating to parasitic fungi, insect pests, and other problems of importance to tropical estates. The past pupils of the botanical department were scattered everywhere in the tropical regions of the Empire.

FIG. 2.—New botany (plant technology) buildings, Imperial College of Science and Technology. Main biochemical laboratory.

Prof. Farmer gave a brief survey of the work of the department, and stated that the number of students had increased from 78 in 1914–15 to 137 in 1922–23, a very large proportion of these being research students. This increase, together with the development of such branches of plant technology as biochemistry and bacteriology, had made urgent the further accommodation which the new building now provided. In the scientific education of plant technologists for tropical regions no attempt was made to give such men any detailed knowledge of tropical agriculture; that could only be satisfactorily done on the rubber estate, the sugar plantation, etc. What was aimed at was a thorough grounding in the fundamental sciences on which plant technology was based.

The Duke of Devonshire said that it gave him much pleasure to come to the College and open the new botany building. He well recognised the importance of tropical agriculture. In tropical Africa alone the area of the British dependencies was many millions of acres, with a population of thirty millions, practically all of whom were dependent on agriculture, which was, however, at present but imperfectly developed. Nothing could more surely contribute to the advancement of such dependencies than the application of science to the many problems of agricultural development. The Colonial Office, in establishing the Imperial Bureau of Entomology and that of Mycology, in founding the Imperial Department of Agriculture for the West Indies, and more recently the College of Tropical Agriculture in Trinidad, had shown a realisation of the importance of science in its application to the problems of the development of the agricultural resources of the Colonies.

A vote of thanks to the Duke of Devonshire was proposed by Sir Frank Swettenham (chairman of the Rubber Growers' Association) and was seconded by Sir Arthur Dyke Acland.

In connexion with the opening ceremony a large number of experiments and preparations illustrative of plant physiology and pathology were on view. One set of exhibits, which will form a permanent series, was arranged to show the diseases to which the rubber plantations are liable. It contained many large specimens which have been procured by skilled men and shipped direct from the plantations. It is safe to say that it forms the most complete exhibition of its kind that has ever been seen in Europe, and there is no doubt that it will be of considerable service to the new department for teaching purposes. Characteristic specimens of the obscure and much-dreaded disease, brown bast of rubber, were also displayed. The methods of investigating diseases were illustrated, and a large series of cultures of bacteria, fungi, and yeasts were on view.

A number of exhibits of physiological apparatus were also to be seen. These took the form mainly of instruments which recorded automatically (usually by an electrical device) the rate of some important vital process of the plant, such as growth, transpiration, change in the size of the pores (stomata) of the leaf, and so on. An apparatus for enriching with carbon dioxide at constant partial pressure the air supplied to growing plants was also included.

Obituary.

DR. C. P. GOERZ.

DR. CARL PAUL GOERZ, the founder of the well-known optical and instrument-making firm of C. P. Goerz, died at his home in the Grünewald, Berlin, on January 14, at the age of sixty-nine years. The record of his life is a remarkable one of industry and perseverance successfully exercised in the creation of a great establishment for the production of scientific apparatus of precision.

Although Dr. Goerz, to whom the honour of Doctor Ing. *honoris causa* was accorded by the Technical High School of Charlottenburg, had received no special academic scientific training, he realised the vital need for the exercise of scientific knowledge and research in such work as that to which he was devoted. His success is attributable to his commercial capacity, to his power of appreciating the value of the leaven of science in industry, and to his ability to utilise and encourage the efforts of those with whom he associated himself.

Towards the end of 1886 Dr. Goerz commenced business in Berlin as a small retailer of mathematical instruments, and later of photographic apparatus. In 1887 he engaged his first employee, the number of whom increased to many thousands during the recent war. The present firm dates nominally from 1888, when a small and simply equipped workshop was established in Berlin for the manufacture principally of photographic cameras. For the optical computation of the objectives he was fortunate in engaging the services of Carl Moser, who died in 1892.

Further progress resulted from the association of Paul Goerz with Ottomar Anschütz, whose pioneer work in the instantaneous photography of animal action had attracted much public attention. But the greatest advance in the fortunes of the firm is attributable to the introduction of the Goerz double anastigmat, designed by a casual applicant for scientific employment, Emil von Höegh.

Thereafter the progress was rapid. The present headquarters and well-equipped workshops were commenced in 1894. Numerous branches were established in foreign countries, and during the war a large mass-production factory was erected in the suburb of Zehlendorf. A separate works was devoted to the production of photographic film and kindred chemical work.

Realising the need for unrestricted supplies of optical glass, Dr. Goerz established on ground adjacent to his mass-production works at Zehlendorf the Sendlinger optical glass works, the origin of which can be traced through the laboratories of Steinheil at Sendlinger near Munich to the original glass works of Fraunhofer.

Dr. Goerz is survived by his second wife and by a daughter and two sons, the children of his first wife who died in 1897.

Through his death the German optical industry has lost a vigorous leader of striking personality, respected by all who were associated with him, and particularly by his many employees, in whose welfare he always exercised an active interest. J. W. F.

THE HON. R. C. PARSONS.

READERS of NATURE will have learned with regret of the death of the Hon. Richard Clere Parsons in London on January 26, in his seventy-second year. After a brilliant career at Trinity College, Dublin, where Mr. Parsons graduated in honours at twenty-two years of age, he was apprenticed to Messrs. Easton and Anderson, and it was during this period that his love of hydraulics developed and became the dominant factor in his life's work. In January 1875 he was asked by Mr. Anderson to make experiments upon centrifugal pumps, and the work culminated in the reading of a paper, entitled "The Theory of Centrifugal Pumps as supported by Experiments," before the Institution of Civil Engineers—a paper which gained him the Miller Prize. This was his first-fruits, and in his later work, both scientific and practical, he continued to be principally concerned with water-flow. Mr. Parsons read many other papers before the Institution, from which he received the Telford gold medal, the Manby premium, and the George Stephenson medal. His first important post was that of resident engineer of the South Hants Water Works; in 1880 he became a partner in the firm of Messrs. Kitson and Co., Leeds; seven years later he entered into partnership with the late J. F. La Trobe Bateman, F.R.S., and so commenced the consulting practice which he continued until his death.

Much of Mr. Parsons's work was carried out abroad; for example, the water supply and drainage of the city of Buenos Ayres, and the scheme which he prepared for the drainage of Petrograd. He held many important consultative appointments, and it was while acting in the capacity of engineer for the Water Works Company of Rosario that his inventive faculty exerted itself in producing an apparatus for automatically adding a coagulant to a water supply before filtration. To this he gave the name Tiltometer. It was followed by another invention called the Senfrot, for adding salt to water when under pressure.

Perhaps Mr. Parsons's most important invention was the Stereophagus pump introduced by him in 1911, and used for the pumping of sewage or water containing solid matter. In this, use is made of revolving blades, which cut up any solids, and thus prevent the possibility of choking. The description of this pump, and also of another, known as the Flexala, which was designed for dealing with fluids containing erosive substances, was given in a paper read before the Institution of Civil Engineers in 1919 entitled "Centrifugal Pumps for dealing with Liquids containing Solid, Fibrous or Erosive Matters."

Mention should be made of the interest which Mr. Parsons took in educational work. During his stay in Leeds he was connected with the development of the Yorkshire College, now the University of Leeds, and he was for thirty-three years connected with King's College, London, of which he was treasurer and vice-chairman. He was also, on the nomination of the University of London, a governor of the Imperial College of Science and Technology, and was a vice-president and manager of the Royal Institution.

MR. W. M. HUTCHINGS.

THE death of a well-known metallurgist, Mr. William Maynard Hutchings, occurred at Harrogate, at seventy-three years of age, on January 17. Mr. Hutchings' school-days were spent at a Moravian school on the Rhine, and he received his technical training in metallurgy and mining at Leipzig and Freiberg. After leaving the University he opened an assay office in Liverpool. Later he spent some years at the lead smelting works at Petrusola in Italy, and after a short period in South Wales became manager of Walker Parker and Co.'s Deebank Lead Works at Bagillt, North Wales, where he replaced the older Pattinsonian process by the then comparatively new Parkes process. In 1889 Mr. Hutchings joined the firm of Messrs. Cookson and Co., Ltd., at Newcastle, as their chief metallurgist and technical manager. In conjunction with the late Mr. Norman Cookson, he designed and installed a large Parkes desilverising plant, which was at the time a model of efficiency. He also introduced for them the first chamber white lead works in this country, which he operated with great success. He retired from active duties in 1915, but held a consulting post with this firm till the time of his death.

Throughout his busy life Mr. Hutchings found time to carry out investigations in other branches of science, and his numerous and lengthy papers on the petrology of shales, clays, and slates published in the *Geological Magazine* created great interest, and are evidence of his active mind and patient capacity for research. He also contributed frequently to several scientific periodicals, and at one time contributed a regular column to *Engineering*. He was an original fellow of the Institute of Chemistry and some time member of the Society of Chemical Industry.

Mr. Hutchings was essentially a strong man, thorough in all his work, a distinguished metallurgist, and a fearless advocate of his own convictions. He was of a retiring disposition, but a lover of Nature, and a notable characteristic was his intense love of animals.

WE regret to announce the following deaths:

Rev. J. C. P. Aldous, author of "An Elementary Course of Physics," and formerly chief naval instructor of the cadets in H.M.S. *Britannia*, on February 18, aged seventy-three.

Prof. E. E. Barnard, professor of practical astronomy in the University of Chicago, on February 6, aged sixty-five.

Prof. J. W. Caldwell, emeritus professor of chemistry in Tulane University of Louisiana, on January 2, aged eighty.

Dr. J. A. Elliott, professor of plant pathology in the University of Arkansas and pathologist in the Arkansas Agricultural Experiment Station, on January 18.

Dr. James Gow, formerly headmaster of Westminster School and author of "A Short History of Greek Mathematics," on February 16, aged sixty-nine.

Prof. S. Günther, emeritus professor of geography in the Technical High School of Munich.

Prof. S. S. Keller, head of the department of mathematics of the Carnegie Institute of Technology, on January 12.

Mr. F. J. Lloyd, agricultural chemist, for many years connected agricultural and dairy societies, on February 8, aged seventy.

Dr. F. Neesen, professor of physics in the Military Technical Academy of Berlin, and known for his work on the determination of trajectories by a photographic method, aged seventy-three.

Prof. W. N. Parker, emeritus professor of zoology at the University College of South Wales and Monmouthshire, Cardiff, on February 22, aged sixty-five.

Dr. Terano, director of the Aeronautical Research Institute in connexion with Tokyo Imperial University and formerly professor of naval architecture in the Engineering College of that University, on January 8, aged fifty-four.

Current Topics and Events.

THE council of the Royal Society has recommended for election into the society this year the following fifteen from the list of candidates:—Dr. E. D. Adrian, Dr. W. Lawrence Balls, Prof. Archibald Barr, Prof. C. H. Desch, Prof. E. Fawcett, Prof. F. Horton, Dr. R. T. Leiper, Prof. J. W. McBain, Prof. J. J. Rickard MacLeod, Dr. G. A. K. Marshall, Sir Douglas Mawson, Dr. W. H. Mills, Dr. J. S. Plaskett, Prof. H. R. Procter, and Prof. W. Wilson.

THE official opening of the new research laboratories of the General Electric Co., Ltd., at Wembley on February 27 was an interesting event. It is probable that this is much the largest industrial research laboratory erected by any firm in this country. The buildings have a total floor space of more than 80,000 sq. ft., and the tour planned out for visitors, comprising a passage through all the laboratories and workshops, involves a walk of something like three miles. There is a well-equipped library, and an organised system of abstracting and recording papers for reference has been devised. Throughout the building, pipes carrying gas, compressed air, a vacuum service, etc., have been installed, the taps being painted in distinctive colours. A feature is the arrangement whereby pipes and electric cables traverse a gallery at the top of the building so that none are carried under the floor, the outlets descending from the ceilings. In addition to the large number of rooms devoted to different sections of research work, there are wood and metal workshops, and a small experimental factory where new types of lamps can be made and tested on a small scale, so as to eliminate all manufacturing difficulties before manufacture in bulk is attempted. In these days, when demand for economy plays such an important part in the programmes of manufacturing concerns, it is interesting to note this enterprising departure, which will doubtless be well repaid.

A CONSIDERABLE amount of attention has been devoted in the daily Press to a paper dealing with various alleged dangers to eyesight of electric light, read by Mr. A. E. Bawtree before the Royal Photographic Society on February 13. One of the points raised, the high intrinsic brilliancy of filaments, has

a certain degree of justification, and various members of the Illuminating Engineering Society who were present at the discussion agreed that electric lamps, in common with other modern illuminants, require proper shading. The effects of ultra-violet light have been thoroughly studied, but it is now generally agreed that the possibility of injury to eyesight being caused by the small proportion of such radiation present in incandescent lamps is remote. Certainly the matter does not deserve to be regarded with alarm. Moreover, photographers should be well aware that the amount of ultra-violet light in natural light is considerably greater than that in most artificial illuminants. Of other problematical dangers such as "X-ray, electron, and undiscovered emanations," the author could present no confirmatory evidence and they were not regarded with any concern by the audience, the speakers dissenting from most of his suggestions. The matter is of interest as furnishing one of those cases in which alarmist statements are indiscreetly published in the daily Press, and relatively small difficulties, easily overcome by reasonable care, are magnified. A little prior consultation with experts in such cases would enable editors to avoid giving publicity to unconfirmed statements which are liable to cause misapprehension on the part of the public.

AMONG the resolutions adopted by the council of the American Association for the Advancement of Science at the December meeting at Cambridge, Massachusetts, is one referring to recent attempts in various parts of the United States to prohibit the teaching of evolution as applied to man. The council asserts its position and that of the Association with its 11,000 members clearly and emphatically in the following resolution: "(1) The council of the association affirms that, so far as the scientific evidences of the evolution of plants and animals and man are concerned, there is no ground whatever for the assertion that these evidences constitute a 'mere guess.' No scientific generalisation is more strongly supported by thoroughly tested evidences than is that of organic evolution. (2) The council of the association affirms that the evidences in favour of the evolution of man are sufficient to convince every scientist of note in the world, and that these evidences are increasing in number and importance every year. (3) The council of the association also affirms that the theory of evolution is one of the most potent of the great influences for good that have thus far entered into human experience; it has promoted the progress of knowledge, it has fostered unprejudiced inquiry, and it has served as an invaluable aid in humanity's search for truth in many fields. (4) The council of the association is convinced that any legislation attempting to limit the teaching of any scientific doctrine so well established and so widely accepted by specialists as is the doctrine of evolution would be a profound mistake, which could not fail to injure and retard the advancement of knowledge and of human welfare by denying the freedom of teaching and inquiry which is essential to all progress."

THE association of Sir Christopher Wren with the Old Ashmolean building at Oxford, to which Mr. R. T. Gunther directs attention in a letter published in our correspondence columns, is of particular interest at the present time, on account of the celebration of the bicentenary of Wren's death. Mr. Gunther's suggestion, that the upper rooms of the building should be used as a science museum, has received the support of practically all the leading members of scientific departments of the University, as well as of others. If this proposal is approved, it is hoped that the valuable collection of old astronomical and other scientific instruments offered by Mr. Lewis Evans to the University will be housed in the Old Ashmolean building, which, should Mr. Gunther's views be correct, will thus be restored to its ancient purpose.

H.R.H. THE PRINCE OF WALES has accepted the presidency of the Empire Forestry Association, and is presiding at the Association's annual meeting at the Guildhall at 3 P.M. on March 2. At this meeting the new council of the Association will be elected, consisting of 45 members—9 for the United Kingdom, 10 for the Dominions, 2 for India, 6 for the Crown Colonies and Dependencies, and 18 for affiliated societies—nine of these representing Overseas associations. The Prince of Wales is proposing the adoption of the report of the Empire Forestry Association, which has made remarkable progress since it was formed as an outcome of the post-war Imperial Forestry Conference. The Association is promoting a permanent exhibition of Empire commercial timbers in London, and will play an important part with regard to the timber section at the British Empire Exhibition in 1924.

A SPECIAL exhibit of abnormal growths taken from trunks, branches, and roots of trees and shrubs has been arranged in Museum IV. at Kew Gardens. The specimens include burrs, witches' brooms, deformed leaves, contorted stems, fasciated shoots, deformed roots, and other items. In some instances the deformity is due to injury at an early period of the plant's life; in others (as in fasciation) it may be caused by luscious growth, while deformed leaves may sometimes be a reversion to a former type. Witches' brooms are usually caused by irritation set up by fungus or insects. They are very common on birch, but occur on many kinds of trees. Burrs on trunks may follow a blow on the bark or the punctures of insects. Burrs are often very large, and the wood is prettily marked. It is in demand for furniture and cabinet work, and often commands a high price. Curved trunks (as in the pine stems exhibited) are brought about by the tunnelling of the larvæ of a small moth. Irregular annual rings are often caused by a tree being fully exposed to sun and air on one side and crowded on the other. Roots are often deformed by growing in gravel beds or between the bricks of walls, whilst the development of aerial roots on trees and shrubs may be due to an injury or to excessive moisture.

AN address on "Biological Contributions to Sociology," delivered by Prof. J. Arthur Thomson before the Sociological Society on February 20, Prof. G. Elliot Smith in the chair, raised a number of questions of wide interest. Knowledge of what may be termed the natural history of man is closely related to the study of social activities and changes, and it should be used to promote the healthy growth of civilised society. Among biological subjects which have a direct bearing upon this development are heredity and environmental influence, variation as the raw material of possible evolution, the relation of individuation and reproduction, population problems, the results of inbreeding and outbreeding in man, the selective influence of disease, and the preservation of the physically unfit in civilised life. As regards the physical characteristics of man, natural selection has ceased to operate in modern society, and the weak and morally or mentally deficient are encouraged to live at the expense of the strong. Society itself will eventually have to decide whether it will continue to promote the reproduction of the unfit or adopt measures of artificial selection with the object of eliminating them. Man can be the master of his own destiny, and is not altogether the creature of circumstances, as are other natural species. The race ought, therefore, to look to scientific guidance for human growth not only towards individual fitness but also towards a higher human perfection.

AT the Royal Asiatic Society on February 13, Mr. E. J. Holmyard delivered a lecture on Arabian alchemy and chemistry, in the course of which attention was directed to the large amount of material available in manuscript form in the libraries of Europe, especially Constantinople, and in Cairo. Mr. Holmyard also expressed the view that it was probable that the laboratory note-books of the chemists of Islam might prove, if they could be found, of at least equal importance with their more famous books. The question of Geber was considered, and some lantern slides, showing typical forms of apparatus, were exhibited. In the discussion which followed, Prof. E. G. Browne laid stress on the need for a thorough and adequate study of the development of chemistry in Islam. Dr. C. Singer disagreed with the lecturer's statement that the Arab chemists kept their chemistry free from astrology, and said that a belief in astrology was a normal part of the mental equipment of all educated men in the Middle Ages. Mr. Robert Steele showed the connexion between Arab chemistry and medieval European chemistry, and Prof. J. R. Partington brought forward further evidence in favour of Mr. Holmyard's views that Berthelot's arguments against the identity of Geber and Jābir ibn Ḥaiyān were unsound. Dr. Gaster pointed out the importance of Berthelot's work on the Greek alchemists, and Mr. H. S. Redgrove suggested that it was rash to assume that the mystical alchemical verse of Khālid ibn Yazīd had no practical meaning.

THE annual general meeting of the Institution of Heating and Ventilating Engineers was held on February 6, and Mr. John Watson was elected president for the year. In his presidential address he stated that they might be proud of the progress of the Institution, in membership and influence, during the twenty-five years of its existence. Several Government departments have representatives on the Institution's committees, showing that its influence is extending. Referring to the education of the engineer, Mr. Watson considered that the facilities now offered are much in advance of anything previously available. At the age of 21 or 22 years, any intelligent youth who has followed the prescribed 6-years course suggested in "Advice to Intending Students" would be well informed in general knowledge of elementary engineering science, and in the basic facts of heating and ventilation. Mr. Watson also referred to some technical matters. The question of super-power stations for the supply of cheap motive power had been discussed by the district heating committee in conjunction with a committee of the Institution of Electrical Engineers. The use of condensing engines in existing stations led to an enormous amount of heat being carried away in the condensing water, whereas by using some of these stations as combined heating and power stations, and utilising the exhaust steam for heating and hot water supply to buildings in the vicinity, something like 50 per cent. of the heat content of the fuel would be realised in useful work, instead of perhaps 12 per cent.

DR. W. H. MAW, president of the Institution of Civil Engineers and past-president of the Institution of Mechanical Engineers and of the Royal Astronomical Society, has been awarded the Bessemer gold medal of the Iron and Steel Institute. The medal was founded by Sir Henry Bessemer in 1873, and is awarded annually to any member or non-member of the Institute who may be (1) the inventor or introducer of any important or remarkable invention, either in the mechanical or chemical processes employed in the manufacture of iron or steel; (2) for a paper read before the Institute, and having special merit and importance in connexion with the iron and steel manufacture; (3) for a contribution to the Journal of the Institute, being an original investigation bearing on the iron and steel manufacture, and capable of being productive of valuable practical results. The medal may also be awarded for work not coming strictly under the foregoing definitions, should it be considered that the iron or steel trades have been or may be substantially benefited thereby. A diploma accompanies the award of the medal, in which it is formally stated that the award is "for eminent services in the advancement of metallurgical knowledge," or, alternatively, "for eminent service in the advancement of the application of iron and steel."

A DINNER to celebrate the twenty-fifth anniversary of the foundation of the Röntgen Society will be held on Thursday, March 15, at the Hotel Cecil, Strand, London, W.C.

THE annual meeting of the Royal Society for the Protection of Birds will be held at the Middlesex Guildhall, Westminster, S.W., on Wednesday, March 7.

MAJOR-GENERAL SIR WILLIAM B. LEISHMAN has been appointed Director-General, Army Medical Service, in succession to Lieut.-General Sir T. H. J. C. Goodwin.

THE degree of doctor of laws *honoris causa* has been conferred on Sir Frederic Kenyon, director and principal librarian of the British Museum since 1909, by Princeton University, New Jersey.

AT the Bristol Museum, according to the report for the year ending September 30, 1922, Mr. F. G. Pearcey has built up in an exhibition case the representation of a living coral reef. "A collection of typical reef corals has been covered with a thin gelatine layer, coloured as true to the living coral as possible, and arranged in natural fashion upon a modelled sea-floor, together with crustacea, mollusca, sea-urchins, and fishes." It sounds simple, but needs in the artist that knowledge of actual reef conditions which Mr. Pearcey possesses, thanks to his voyages in the *Challenger* and other exploring ships.

AMONG the books to be published during the spring and summer this year by the Clarendon Press and the Oxford University Press are: Vol. 5 of the translation of Suess's "The Face of the Earth," being the index of subjects and of persons and places; "The British Coal-mining Industry during the War," Sir R. A. S. Redmayne, comprising chapters on the pre-control period—1915–16, the period of government control—1917–18, de-control—1919–21, general survey of the coal-mining industry of the United Kingdom during the period 1914–21 and appendixes; "The Legacy of Rome," edited by C. Bailey, with the following contributions: Religion and Philosophy, C. Bailey, Family and Social Life, H. Last, Literature, J. W. Mackail, Language, H. Bradley, The Science of Law, F. de Zulueta, The Conception of Empire, E. Barker, Roman Architecture and Art, G. McN. Rushforth, Science, Dr. C. Singer, Administration, H. Stuart-Jones, Communications and Commerce, G. H. Stevenson, Agriculture, W. E. Heitland, and Engineering, G. Giovannoni; "Makers of Science," I. B. Hart, in which an attempt is made to present a survey of the broader movements in the history of the physical and mathematical sciences from Greek days to the present time.

Our Astronomical Column.

PARTIAL ECLIPSE OF THE MOON.—A partial eclipse of the moon will occur during the morning hours of March 3, and may be well observed if the atmosphere proves favourable. The moon will enter the denser shadow of the earth at $2^h\ 28^m$ A.M., the middle of the eclipse will be at $3^h\ 32^m$ A.M., and our satellite will emerge from the shadow at $4^h\ 36^m$ A.M. The fainter shade or penumbra will also involve the moon between $1^h\ 13^m$ A.M. and $5^h\ 51^m$ A.M. The northern or upper region of the disc will be obscured, and if we regard the whole surface as equal to 1·0 the proportion eclipsed will amount to 0·38, or nearly two-fifths. This eclipse is a return of that of February 19, 1905, when the magnitude was about three-tenths.

The cycle of recurrences in eclipses is equal to 18 years and 11 days and was discovered by the Chaldæans, who named it the Saros. It enabled the ancients to foretell the return of these phenomena with tolerable accuracy.

THE ATMOSPHERE OF VENUS.—Mention has been made in this column (May 6, 1922, p. 592) of the result obtained by Prof. St. John and Mr. G. B. Nicholson, at Mt. Wilson, demonstrating the absence of the lines of water-vapour and oxygen in the spectrum of Venus. A paper by them in *Astrophys. Journ.*, December 1922, gives full details of the investigation, with beautiful reprints of the spectra, which are arranged to make the Doppler displacement of the solar lines in the spectrum of Venus clearly visible, while it is absent for the water-vapour band, showing its telluric origin. It is stated that the spectra confirm Prof. Slipher's result that fifteen days seem to be an inferior limit for the period of rotation of Venus.

A review is given of former results. Vogel, Scheiner, and Arrhenius all concluded that water-vapour is present on Venus from the apparent strengthening of its spectral bands; but obviously the use of the Doppler principle with a high dispersion is far more decisive. It is concluded that the quantity of oxygen in the atmosphere of Venus can scarcely exceed a thousandth of that in our own, or it would have been detected.

The authors quote the suggestion of Arrhenius that the oxygen in our atmosphere may have resulted from plant life, so that if Venus had no organisms on it oxygen would not be present in its atmosphere. Proceeding to speculate on the conditions on the planet, they consider that the slow rotation would be likely to cause violent air circulation, owing to the great difference of temperature between the day and night hemispheres. It is supposed that the rotation, though slow, is not so slow as to put one hemisphere in perpetual night. The absence of water would make the ground very dusty, and high winds would raise dense clouds of it. It is suggested that this is the nature of the Venus clouds. According to Prof. Russell their albedo is less than that of our clouds. It is suggested that direct photographs through violet and infra-red filters, as used by Prof. R. W. Wood on Jupiter and Saturn, would give information about these clouds, and might even reveal the surface below in regions where they were thin.

THE RADIAL MOTIONS OF STARS OF TYPE N.—This type (Secchi's Type IV.) consists of red stars with carbon bands. Lick Observatory Bulletin No. 342 contains a study of the velocities of twenty-five of these stars in the line of sight by J. H. Moore. Twenty-three of these stars have well-determined proper motions, and a correlation of these with the radial velocities enables the mean parallax of the group to be determined. Three different methods of treating the data give the closely accordant values of the latter 0·0032″, 0·0028″, 0·0031″. The mean apparent magnitude of these stars at maximum is 6·1, which implies a mean absolute magnitude of −1·5, in good agreement with the value −1·3 found by Luplau-Janssen and Haarh from the proper motions alone. This gives confidence in the result.

It appears that these stars are giants, in an early stage of their career as stars. Till the Giant and Dwarf Theory obtained currency, the red variable stars were generally looked on as expiring suns, and compared to a candle flickering in its socket before extinction, but this new research combines with many others to show that this view is incorrect.

Research Items.

PSYCHOLOGY IN ENGINEERING.—In his Sidney Ball memorial lecture (Scientific Management and the Engineering Situation, Barnett House Papers, No. 7, Oxford University Press, 1922. Price 1s.), Sir William Ashley discusses the much debated problem of scientific management, with special reference to the engineering trade. He reviews its beginning in America, its development there, and the interest aroused in it in this country. He points out that, as it has arisen in the engineering trade, it bears the marks of people accustomed to think in terms of the exactly measurable, engineering being largely a matter of exact formulæ. Unfortunately for the mechanist, the human being is quite frequently influenced by motives which defy exact measurement. Aiming at increasing output and thereby diminishing the cost for each unit of work, it was attempted by time and motion study and a bonus system to settle the problem of wages. It has, however, introduced more complications to an already complicated problem, and just where it leaves the domain of mechanics to enter that of psychology, it breaks down. English psychologists criticise the so-called scientific management, not because it calls itself scientific, but because it is not sufficiently scientific. The application of science to industry is valuable, but it is not scientific to apply the principles of one science to problems belonging to another of a quite different order.

FLEAS AND PLAGUE IN INDIA.—One of the most striking features of the prevalence of plague in India is the relative immunity of Madras compared with, for example, Bombay or the Punjab. The Advisory Committee for Plague Investigation examined the problem at length, but failed to find any satisfactory explanation. It was believed at that time that the prevalent rat flea all over India was *Xenopsylla cheopis*. Rothschild, however, afterwards found that under that identification three very closely allied species—*X. cheopis*, *X. astia*, and *X. brasiliensis*—had been confused, and Hirst pointed out that the distribution of plague in India and Ceylon corresponded well with the hypothesis that the real *X. cheopis* was alone an effective transmitter of the disease. He now reports (*Indian Journal of Medical Research*, vol. x., 1923, p. 789) a full series of experiments confirming his earlier work, and showing that *X. astia*, the prevalent rat flea in Madras, will carry plague from one animal to another only with much more difficulty than *X. cheopis*, the rat flea of Bombay. Details of plague epidemics in Colombo, where plague has never become widely spread and where the fleas are mostly *X. astia*, with a few *X. cheopis*, bear out his thesis in a striking manner. It seems as if a considerable advance has been made in the epidemiology of plague which illustrates the fundamental importance of systematic zoology in these problems.

EFFECTS OF THE CONTIGUITY OF ORGANISMS.—In a series of experiments on the influence of density of population on longevity in the fly Drosophila, R. Pearl and S. L. Parker show (*American Journal of Hygiene*, vol. iii., 1923, p. 94) that the optimal density for duration of life is not the minimal density The mean duration of life increases with increase of density of population up to a certain point, and afterwards, as would be expected, declines. Thus, starting with about 2 flies per ounce bottle the average life is 28 days, which increases rather rapidly to about 40 days with 50 flies per bottle, declines again to 28 with a density of about 90, and to 17 and 13 with densities of 150 and 200. This favouring effect of organisms on one another recalls the observations of T. B. Robertson (*Biochemical Journal*, vol. xv., 1921, p. 612), who found that the rate of asexual multiplication of the infusorian Enchelys was much greater if the culture contained two individuals to start with than if only one was present. It is too familiar to most bacteriologists that the dispersion of a few bacteria in a large volume of culture liquid will often fail to give a successful growth which is obtained with certainty if the same number of organisms is sown in a small quantity of medium. All this suggests a general proposition that contiguity to like individuals is, up to a certain point, favourable to the life of organisms.

CORK FORMATION.—In a continuation of the useful physiological studies in plant anatomy carried out at the University of Leeds, Prof. J. H. Priestley and Miss L. M. Woffenden (*New Phytol.*, vol. 21, No. 5) have made a study of the causal factors in cork formation. A causal sequence can be traced both in the formation of wound cork and leaf scars, as well as in the natural internal origin of a cork layer. A parenchyma surface is first blocked by suberin deposits in presence of air. This is followed by the accumulation of sap at the blocked surface, and this in turn gives rise to the development of a phellogen or cork cambium in the area involved. In the absence of air, a meristematic zone may be artificially produced without the formation of cork in the cell walls.

GROWTH AND MATURATION OF THE SUGAR CANE.—Dr. Kuyper has described the physiology of sugar formation, and the methods used in Java to harvest the canefields at the exact moment of highest maturity in "The Formation of Sugar and the Ripening in Sugar Cane" (Suikervorming en ryping by het suikerriet), Archief voor de Suiker-industrie in Nederlandsch Indië, 1922, 2e deel blz. 195-321, Mededeelingen No. 5. Cultivation is so directed that the fullest use is made of the available light, and in this connexion the author discusses the questions of the optimum distance between the plants and rows, the effect of tying up the canes as a preventive against lodging, the influence of yellow stripe disease upon sugar production, and the relation between cellulose formation and sugar content. In Java the process of ripening of sugar cane is carefully watched by means of analyses of samples taken regularly every two or three weeks. The course of maturity can be judged by the relation between total solids and the quotient of purity (Brix and RQ) in the different parts of the stalk; the glucose ratio changes in a way which is the reverse of that seen in the percentage of available sugar. It has been proved that the time of planting and the age of the cane have much influence upon the maturation process, as if climatic conditions are favourable the sugar content of fields of different ages may reach almost the same final percentage, whereas under unfavourable conditions the late planted canes will not be so rich in sugar. Maturing is found to progress most regularly in places in which the rainfall is very low during the milling season, but where the soil contains sufficient moisture to prevent the cane from dying without permitting further growth to occur.

OCEANOGRAPHY OF THE SOUTHERN OCEAN.—A note by Commander F. A. Worsley in the *Geographical*

Journal for February gives some account of the hydrographical work of the *Quest* expedition. Thirty-two soundings were taken in the Southern Ocean. The first series was from a point 500 miles east of the South Sandwich Group to about lat. 60° 45′ S., long. 4° E., and then to lat. 69° 18′ S., long. 17° 11′ E. The position and details of the soundings are not given, but it would appear that water of practically 3000 fathoms was crossed in the supposed "deep" in the Biscoe Sea. Shoaling water towards the south, practically where Bellingshausen made his southern attempt in 1820, confirmed that navigator's belief in the occurrence of land not far off. A depth of 1089 fathoms might occur within 50 miles of the Antarctic continent. From this point an irregular line of soundings was carried westward across the mouth of the Weddell Sea towards Elephant Island. These confirmed the discoveries of the *Scotia* and *Deutschland*, which showed the Weddell Sea to be approximately 2500 fathoms in depth. No soundings were taken between Elephant Island and South Georgia, and only three were taken between South Georgia and Tristan da Cunha. None appears to have been taken in the uncharted waters to the east of the South Sandwich group. It is most unfortunate that heavy weather prevented oceanographical work exactly in those areas where the gaps in knowledge are widest. A search for a reported reef 350 miles E. by N. of Tristan da Cunha showed that it does not exist. The paper also contains a new map of Gough Island and some additional surveys in South Georgia.

OIL EXPLORATION IN NEW SOUTH WALES.—The Federal Government of Australia recently offered a reward of 50,000*l.* for the discovery of commercial deposits of petroleum within the continent, in order to encourage private enterprise in prospecting. Not content with this, the New South Wales Government has made a further offer of 10,000*l.* for the discovery and production of 100,000 gallons of natural mineral oil within the State, and so that such enterprise, if undertaken, should be carried out with at least a technical chance of success, a blue-book has been prepared by the Geological Survey of that State, which discusses petroleum and natural gas and the possibilities of their location within its confines. The publication is a credit to all concerned, but more particularly to its author, Mr. Leo J. Jones, who, writing primarily for the non-technical public, has set forth the principles of oil production in a commendably lucid manner. By following the text of the first five chapters of the pamphlet carefully, no ultimate failure can be set down to ignorance, and the "wild-catter," if unsuccessful, can reasonably plead ill-luck. The two concluding chapters review past operations for locating oil-pools in New South Wales and discuss the possible areas awaiting exploration. A complete stratigraphical succession for the State is quoted, and forms the basis of a brief survey of the oil potentialities of each formation. In the summary, however, we are acquainted with the official opinion regarding future oil possibilities, two extracts from which read as follows: "The prospects of obtaining commercial supplies of oil in New South Wales are by no means bright . . .," and again ". . . New South Wales will have to depend for its oil supplies, not upon deposits of crude petroleum, but upon the mining and distillation of oil shales . . ." already known to occur extensively in the state; with which observations we are in entire agreement. It would thus seem that the New South Wales Government is reasonably safe in offering the reward quoted, and, for that matter, the Federal Government is probably in a similar position.

METEOROLOGY IN MYSORE.—The twenty-ninth annual report for 1921 and a separate report on rainfall registration in Mysore for 1921, prepared under the direction of Mr. N. Venkatesa Iyengar, meteorological reporter, have recently been published by the Mysore Government. The annual report contains data for the four observatories, Bangalore, Mysore, Hassan, and Chitaldrug. Monthly means for the several elements are compared systematically with the respective normals for 29 years. Annual means of temperature at the four observatories differed by rather more than 4° F., Bangalore being the coldest with 69°·2 F. and Chitaldrug the warmest with 73°·6 F. Rainfall for the year was greatest, 36·62 in., at Bangalore, which is 1·43 in. more than the normal, the least, 24·37 in., at Chitaldrug, which is 0·50 in. less than the normal. According to the report on rainfall registration, rain is measured at 226 stations, the mean for the State being 36·19 in. against an average of 36·10 in. The greatest rainfall in 24 hours was 14·60 in. at Agumbi in the Shamoga District on July 30. The two heaviest falls of rain in 24 hours during 1921 are given for each of the rainfall stations. Percentage of the rainfall is given for each season in each district and for the State as a whole. For the State in the cold weather period, January and February, the percentage of the normal was 238; in the hot weather period, March to May, it was 3 per cent. deficient; in the south-west monsoon period, June to September, it was 5 per cent. deficient; and in the north-east monsoon, October to December, it was 11 per cent. in excess. The rainfall is given for the several river basins, and the departure from the normal. The detailed results are of considerable value to the world's meteorology.

CONCENTRATION OF MINERALS BY MULTIPHASE MAGNETS.—The problem of the utilisation of multiphase currents for the separation of minerals from ore continues to be developed by Mr. W. M. Mordey. An important paper on the subject, which he read in December 1921 before the South African Institution of Electrical Engineers, was dealt with in an article by Prof. Truscott, of the Royal School of Mines, in NATURE of April 29 last year. Experiments illustrating the physics of the method were shown last summer at the conversaziones of the Royal Society, and were repeated with some extensions on the occasion of the Silvanus Thompson Memorial Lecture at Finsbury Technical College on February 1. Meanwhile, in the Bessemer Laboratory of the Royal School of Mines the process is assuming a character approaching practical requirements. A stream of "pulp," consisting of crushed mineral in water, is passed down a launder, under which is placed a multiphase magnet. The magnetic field causes the mineral constituents to move gradually to one side of the stream, leaving the gangue on the other side. In this test the material principally made use of is an ore of Norwegian specular hæmatite, a crystalline oxide of iron, which, being almost *non-magnetic*, is not amenable to treatment by ordinary magnetic separators. Under the influence of the multiphase magnet, the particles of this material can be seen moving steadily across the stream, from one side of the launder to the other, in a way that will be understood by those who have witnessed these experiments with dry materials. The test has also been carried out with an ore of magnetite. This powerfully *magnetic* material is, for the most part, held stationary over the poles of the multiphase magnet; but when the field is reduced in strength, its action resembles that of specular hæmatite, *i.e.* the concentrate forms on one side of the stream, and the gangue is washed down on the other.

The Unit Activity of Animal Organs.

ONE of the most remarkable features of the animal body is the fact that each organ has more substance than is necessary to do its normal amount of work. Teleologically it is easy to see that some such arrangement is necessary for successful survival, but it is more difficult to imagine the mechanism by which it is kept in working order. If a muscle is used less it grows smaller, and if it is used more it grows larger. In each case it preserves the margin of power which is known as "reserve force," despite the definite general relation between quantity of substance and quantity of function. In a recent number of the *Journal of Pathology and Bacteriology* (vol. xxv. p. 414) Dr. V. R. Khanolkar makes some interesting speculations and observations which seem to throw light on the problem, and he extends them into suggestions which may clear up some obscure points in respect of the distribution of pathological lesions in organs. So long ago as 1871 Bowditch formulated the proposition that if the frog's heart responds at all to an artificial stimulus it responds with the greatest contraction of which the muscle is at the time capable. This principle of "all or nothing" has since been extended to other excitable tissues, most convincingly to muscle and nerve, and by implication to glands which receive their normal stimuli through the nervous system. On this basis, moderate activity of a skeletal muscle means maximal activity of a moderate number of the units, in this case muscle fibres, of which it is made up and not moderate activity of all the units.

In other words, in ordinary circumstances only a proportion of the units of any organ are active at any one time. How then do the other units escape the consequences of the rule that tissue which is not used atrophies and disappears? Marey in 1885 found that the responsivity of the frog's heart to external stimuli is least when it is actually contracting and is only gradually restored to normal after the contraction is over. Each period of activity is thus followed by a "refractory period" in which the tissue will not respond to a strength of stimulus which would normally rouse it to activity, the resistance to excitation fading away until the normal excitability is regained. This refractory phase has been closely studied in nerve muscle and sense organs, and Gotch described it as a general phenomenon of living substance. In this way a rotation of activity among the units of any organ is brought about: with moderate activity in response to moderate stimulation a proportion of the units are constantly in action, but as the refractory period of each one comes on it stops working and its function is taken on by another unit with its activity more remote and its refractory period completed. As the activity of the whole organ is increased owing to stronger stimulation, the refractoriness of units is broken through first in those the activity of which is remote, next in those which have functioned more recently. Finally, with maximal stimulation all the units are forced into simultaneous action.

It seems likely that these principles, elucidated by the classical method of "wiring frogs on to machinery," are applicable to other tissues in which their demonstration is more difficult. What constitute anatomical "units" is not known. In nerve and muscle they are the individual fibres, in the central nervous system probably nerve cells, in the kidney possibly the glomerular-tubal systems, in glands apparently groups of adjacent cells—but they might be parts of organs, cells, or even parts of cells. Dr. Khanolkar has specially concerned himself with the kidney, and supposing that each glomerulus with its efferent tubule is a unit, points out that the hypothesis would explain the irregular distribution of the lesions in the common chronic degeneration of that organ. Assuming that the original injury is due to some poison circulating in the blood, it follows that more of it will reach active than passive units since activity is always associated with a local increase in blood supply. On general grounds also it is quite likely that functioning cells are more reactive and hence more easily poisoned than cells at rest. In chronic general nephritis some glomeruli are destroyed while others appear to escape injury altogether, and the diseased and healthy units are found scattered uniformly all over the organ. It is suggested that the injured units are those which happened to be active when a toxic concentration of the poison was in the blood. Extending the idea to other organs, it follows that activity always renders a tissue more susceptible to poisonous substances, which may be the explanation of why the parts of the nervous system most constantly in heavy use are specially liable to suffer in general lead poisoning and other similar relations. Failure of an organ from over use might in part be due to this, in part to the absence of rest for any of the units. It is well recognised that hypertrophy of skeletal muscle is best secured by exercises which seem absurdly mild: on the hypothesis of unit activity it is easy to understand why light dumb-bells should keep more units in the best possible condition than heavy ones.

Dr. Khanolkar adduces experimental evidence that in the kidney during moderate activity only some of the glomeruli are in action, while more or all will excrete actively when the organ is strongly stimulated with diuretics. Incidental observations on the adrenal medulla, pituitary, pancreas, and salivary glands give histological evidence of the same partial activity. The whole fits in well with Krogh's recent demonstration that many capillaries in normal organs are at any one moment closed and out of action.

Climates of the Past.

W. R. ECKARDT, of Essen, has contributed a memoir, "Paläoklimatologie, ihre Methoden und ihre Andwendung auf die Paläobiologie," to Prof. Abderhalden's comprehensive "Handbuch der biologischen Arbeitsmethoden" (Urban und Schwarzenberg, Berlin), of which it forms Heft 3 of Abteilung 10. It is written in what may be called the *über Alles* type of German, without much consideration for the southerner or the stranger, and sentences containing more than 100 words are not uncommon. It embodies, however, a valuable and critical review of the way in which various classes of geological evidence may be used as indications of the climatic environment of the faunas and floras of the past.

The character and colour of fossil soils are discussed by Dr. Eckardt, equally with the distribution of

fossil organisms. It is pointed out that areas of bogland (*Sumpfflachmoor*) and peat may arise even in tropical conditions, moisture and low-lying land being the real necessities, and Wegener is cited as regarding all the great coal-basins as formed in a zone of equatorial rains. The important question of annual rings in wood, discussed recently in Deecke's "Paläophytologie" (see NATURE, September 16, p. 375), receives careful consideration, and the author concludes that these rings cannot be used by themselves as elucidating climatic conditions. Dr. Eckardt supports the view that seasonal changes of temperature have been felt in polar regions even when the climate was warmer over the whole earth; but at certain periods mild subpolar winters have been associated with summers much hotter than those of the present day.

A. Handlirsch is interestingly quoted as showing how the length of the anterior wing in insects may be used as an indication of prevalent temperature, since it increases at the present day from an average of 7 mm. in central Europe to 16 mm. in the tropics. The length in Lower and Middle Carboniferous strata in our latitudes is as much as 51 mm., but decreases in Upper Carboniferous and Permian times to 20 or to 17 mm. Little that bears on his subject has escaped Dr. Eckardt, and the correlation of scattered scientific observations, in the hope of solving problems, is aptly illustrated in his concluding sentence, where he quotes Eckholm as showing that great importance must be attached to the obliquity of the ecliptic in explaining the post-Glacial distribution of the hazel-nut in Scandinavia.

Dr. Eckardt points out that at the present day the relative distribution of land and water has an influence on climate only about a third or a quarter as important as that of latitude. Prof. E. W. Berry, however, in a paper on a possible explanation of Upper Eocene climates (Proc. Amer. Phil. Soc., vol. 61, p. 1, 1922), urges that a prevalence of low-lying land as against mountain areas, and an enlargement of oceanic areas, allowing of free circulation from broad equatorial basins to the poles, was a sufficing cause of the warmer, though still zonal, conditions revealed by Eocene vegetable remains. The Upper Eocene hazel, for example, came no farther south in Eocene times than lat. 45°, because the Atlantic basin resembled in breadth that of the present Pacific Ocean. The author even looks back to the views of Lyell, and suggests that "the distribution and altitude of the land and sea" may have accounted for the glacial epochs.

A. Brockmann-Jerosch, who is much quoted by Dr. Eckardt, has recently suggested that glacial conditions in Switzerland were favoured by an oceanic climate and a copious rainfall ("Die Vegetation des Diluviums in der Schweiz," Conférences de la Soc. Helvétique des Sci. nat., 1920, p. 73). Perhaps the proximity of the mountains in this area removed one of the factors relied on by Berry. There is clearly much philosophical discussion still before us in palæoclimatology. G. A. J. C.

Studies on Phytophthoras.

IN the *Mededeelingen v. d. Landbouwhoogeschool*, Wageningen, xxiv., No. 4, 1922, Miss de Bruyn publishes (in English with a Dutch summary) a paper entitled "The saprophytic life of Phytophthora in the soil." After reviewing the literature pertaining to fourteen species of the genus in relation to the question of their capacity for life as saprophytes in the soil, Miss de Bruyn describes her own work on the cultivation of the three species, *P. Syringæ*, *P. erythroseptica* and *P. infestans*, in soils of different types. Most of the experiments were carried out with soil which had previously been sterilised, and details of the growth in this medium are given in each case.

The general conclusion reached is that Phytophthoras are not such obligate parasites as was formerly supposed, and it is claimed that the experiments carried out prove that each of the species mentioned can actually live and grow in the soil. Cultures on sterilised soil as well as on other media were exposed out of doors to rather severe frost for several days, and it was found that *P. Syringæ* and *P. erythroseptica* survived such treatment. So far as the cultures in soil are concerned, however, it would appear that such survival may have been due to the presence of oospores. In the case of *P. infestans* (the oospores of which are still unknown in Nature) the results of exposure to similar conditions were not concordant, and the question as to whether this species can overwinter in the soil is regarded as unsolved. It was found, however, that when growing on sterile raw potato slices, *P. infestans* survived a temperature of −9° C., although at this low temperature the potato slices themselves were blackened.

Attempts were made to cultivate *P. Syringæ* and *P. erythroseptica* in non-sterilised soil, but the results do not appear to have been very satisfactory. It seems clear that further and more critical work will have to be carried out before it can be accepted as convincingly established that these two fungi are really capable of sustained growth and development in ordinary soil. No information is given as to whether *P. infestans* was found to live and grow in ordinary unsterilised soil; and speculation as to whether the survival of this fungus in the soil from season to season may account for primary outbreaks of potato blight seems therefore altogether premature.

Another recent contribution to our knowledge of this fungus is contained in a doctorate thesis presented to the University of Utrecht by Miss M. P. Löhnis, entitled "Onderzoek over *Phytophthora infestans* (Mont.) de By. op de aardappelplant." (Wageningen, H. Veenman, 1922.) An account of pure culture work with various media is given; immature oogonia and oospores were found twice in cultures on raw potato and Quaker Oat agar.

Experiments on the manner in which infection of the potato occurs are described, and in discussing the question of the propagation of the blight from season to season it is recorded that on five occasions a diseased tuber was found before any infection of the foliage was apparent. It is suggested that the fungus may perhaps subsist in the soil, but this point is not yet regarded as definitely established. Other matters dealt with are the influence of the stage of development of the plant on its susceptibility to infection, the mode of entry into the tubers and growth of the fungus in the subterranean parts of the plant, the formation of wound cork and varietal resistance to blight. The thesis is provided with a summary in English, and a more detailed abstract of it will be found in the *Review of Applied Mycology*, I. 8. Aug. 1922, p. 253.

Aeronautical Research Committee.

THE report of the Aeronautical Research Committee for the year 1921–22 (H.M. Stationery Office, 1922, 2s. 6d.) consists of two parts. The first—the report proper—gives a formal résumé of the activities of the committee, and of its sub-committees on air-inventions, aerodynamics, engines, materials and chemistry, meteorology, accidents, fire prevention, and load factors. A feature of great interest in this report is the reference to the loss of the Airship R38 and of the valuable lives thus cut short. The committee deprecates the tendency to make development in aircraft depend upon the investigation of accidents, and advocates strongly the method of systematic research directed to each element of the design. It asserts the necessity of employing the highly trained and skilled researchers that are now available for the scientific study of aeroplane and airship development, and on the question of finance counters the "axe" enthusiasts as follows: "The money which would have come to this country had R38 been a success would have maintained the research of the Committee in full activity for a period of five years. In another way it may be stated that, should the work of the Committee lead to a reduction by one of the aeroplanes written off per year as a result of crashes, it would have earned the cost to the Air Ministry of the fees paid to its members." This is a sufficiently cutting condemnation of so-called "economy," but one wonders how much effect it will produce in official circles.

The second part of the report consists of a supplement, giving in some detail an account of the researches that have been and are being conducted, with indications of their scope and results. In aerodynamics the chief topics studied have been control at low speeds, the general theory of aeroplane flight (investigated by Prof. G. H. Bryan), aerofoils, the circulation and vortex theory of Prandtl, etc. On internal-combustion engines work was done on trustworthiness, sparking-plugs, fuels, etc., while it is of interest to read that a beginning is being made (at Cambridge University and at Armstrong College, Newcastle) to bring University workers into contact with Government aircraft research. The meteorological work dealt with the structure of the atmosphere and the formation of cyclones and fog, and with instruments, etc.

The part of the supplements dealing with accidents will naturally attract much notice. The accident to the Tarrant Triplane "Tabor" led to the discovery of inadequacy in the rudder control, and to the development of relay controls for dealing with the longitudinal control plane. Airship R36 suffered accidents which showed the necessity for experimental work on an actual airship. In the case of the R38 the disaster was due to structural weakness in the design. No calculations had been made of the stresses caused by aerodynamical forces and movements, although such stresses may exceed considerably those due to weight and buoyancy. While it appears that model data would, indeed, have been sufficient to indicate the kinds of stresses that would be obtained in flight manœuvres, the committee emphasises the importance of full-scale work.

It is not possible here to mention all the numerous items of aeronautical research referred to in the report. Suffice it to add that, at a ridiculously small cost to the nation, work is being done that will add as much to our national security and commercial prosperity as the many millions we spend so thoughtlessly in response to popular clamour.

The Hydrautomat.

THE problem of raising a small quantity of water to a considerable height by utilising the energy of a larger mass of water has been solved in a number of ways. In the seventeenth century, the City of London was supplied with water pumped from the Thames by means of a reciprocating pump, driven by a crank which was made to rotate by a water-wheel turned by the flow of the river. The "hydraulic ram" is a device that has been successfully used, and recently there has been developed a device, the hydrautomat, which utilises the pressure of the atmosphere to lift water (Allen Hydrostatic Pump Syndicate, Ltd., 110 Victoria Street, S.W.1).

Let it be supposed that there is a source of supply at a height of H feet above a tail race. For example, water might be led along a channel constructed by the side of a falling stream, the slope of the channel being less than that of the stream, to some point at which there is a difference of level H feet between the water surface in the channel and the river. At a height H/2 from the river bed is constructed a closed tank which is connected to the supply channel by means of a siphon pipe entering the closed tank at the bottom, and to the bottom of the tank is connected another siphon which has a rising limb and a discharging limb taken down to the river bed. To the top of the closed tank is connected an air-pipe which has connexions to a series of closed tanks placed at various heights, on a hillside, say. Each of these closed tanks has a siphon pipe led from the bottom of the closed tank to the top of an open tank at a higher level. From the top tank of all the water can be taken to any desired point.

Let now the water be allowed to flow from the channel into the lowest closed tank, entering at the bottom. The air in this tank will be compressed and will be conveyed under pressure along the rising pipe, and to each of the closed tanks above, from which the water is raised to the open tanks above. When the pressure in the lowest tank reaches a certain value, the discharging siphon automatically operates. The escaping water acts upon a flat vane, which is connected to a lever controlling a valve which cuts off the supply from the channel to the lowest tank, and a partial vacuum is produced in the closed tanks. Water is thus drawn from any one of the open tanks to the closed tank immediately above it. There is thus an alternate delivery and suction stroke for each lift of ½H. The only valve is that between the channel and the lowest tank. The device is an exceedingly interesting and simple one, and the plant required is inexpensive in first cost and upkeep. A plant is working at Carshalton, Surrey.

University and Educational Intelligence.

BRISTOL.—A tablet bearing the names of all members of the University who fell in the war is shortly to be placed in the new University buildings. The war memorial committee is very anxious to guard against omissions, and will be grateful if relatives of the fallen who have not already communicated particulars will inform the secretary of the committee accordingly.

CAMBRIDGE.—The offer of the Ministry of Agriculture to found a professorship of animal pathology with funds from the Development Commissioners has been accepted. The Council of the Senate has published recommendations as to the duties and emoluments of the professorship, and if these are approved the election to the new chair need not be long delayed.

LEEDS.—At a meeting of the Council on February 21, Prof. Smithells was reappointed to the office of Pro-Vice-Chancellor.

Mr. James Robb has been appointed district lecturer in agriculture.

It has been decided to reinstitute a formerly existing professorship of therapeutics in the department of medicine, and to elect Dr. W. H. Maxwell Telling to this chair.

LONDON.—The Senate has made a grant of 75*l.* from the Publication Fund to the Rev. F. J. Wyeth in aid of the publication by the Royal Society of his D.Sc. thesis entitled "The Development of the Auditory Apparatus and Associated Structures in *Sphenodon Punctatus*."

The Senate has adopted a resolution recording with great regret the resignation of Dr. M. J. M. Hill of the Astor chair of pure mathematics at University College, which he has occupied since 1884.

The Academic Council has prepared a table showing the universities from which, up to the present, applications have been received for registration as Internal Students for the Ph.D. degree. The classified totals are as follows :—

Great Britain (London 171) and Ireland	255
Europe	10
Australia and New Zealand	16
United States of America	30
India	62
South Africa	3
Canada	8
Japan	1
	385

The degree of D.Sc. (*Engineering*) has been conferred upon Mr. A. E. Clayton for a thesis entitled "Papers on Alternating Current Machinery" and other papers.

The council of Bedford College for Women invites applications from women for a post-graduate scholarship in sociology, value 150*l.*, for one year. Further information is obtainable from the Secretary of the College, Regent's Park, N.W.1.

MANCHESTER.—The Council has approved a scheme for the establishment of a Colloids Research Laboratory in the University. A sum of 11,842*l.* has been subscribed and given to the University towards the endowment and cost of the equipment of the department. Mr. D. C. Henry, at present a lecturer in chemistry, has been appointed lecturer in colloid physics and will take charge of the Laboratory, which will be known as "The Graham Research Laboratory." The Council has expressed its hearty appreciation of the gift to the various subscribers, and especially to Dr. Kenneth Lee, who has been largely responsible for the scheme.

Mr. Norman B. Maurice has been recommended for the degree of Ph.D., his thesis being "On the Unsaponifiable Constituents of Commercial Rosins."

OXFORD.—The Edward Chapman Research prize of Magdalen College is to be offered for competition at the beginning of the summer term this year for a published piece of original research in one of the following departments of natural science: physics or chemistry, including astronomy, meteorology, mineralogy, geology, or the biological sciences of zoology and botany, whether treated from the morphological, palæontological, physiological, or pathological point of view. The prize is of the value of 20*l.* and restricted to members of Magdalen. Further particulars are obtainable from Mr. R. T. Gunther, Magdalen College. Competing essays must reach him not later than May 1.

THREE fellowships, tenable for two years, each of the annual value of 200*l.*, are being offered by the University of Wales to graduates of that university. Applications must be received before June 1 next by the Registrar, University Registry, Cathays Park, Cardiff, from whom further information may be obtained.

NOTICE is given that the tenth election to Beit fellowships for scientific research will take place on or before July 16 next, and that the latest date for the receipt of applications is April 19. Forms of application and all information may be obtained from the Rector, Imperial College, South Kensington, S.W.7, upon written request.

A LECTURE on the work and aims of the newly-established West Indian Agricultural College, Trinidad, will be given at Vernon House, Park Place, St. James Street, S.W., at 8 P.M., on Monday, March 5, by Mr. W. R. Dunlop, of the Imperial Department of Agriculture, who has taken an active part in the organisation of the College. The chairman at the lecture will be Dr. A. W. Hill, director of the Royal Botanic Gardens, Kew.

THE next meeting of the Imperial Education Conference is to be held in London at the end of June of this year. The last meeting was held in London in 1911, and but for the war the Conference would have met in 1915. The Conference will be attended by official representatives from the Education Departments of the Self-governing Dominions and Colonies and the British Isles, and various matters of common interest will be discussed, including the question of the interchange of teachers within the Empire.

THE third report of the British Association Committee on Training in Citizenship, presented at the Hull meeting in September last, has recently been issued and is obtainable from the secretary of the committee, Lady Shaw, 10 Moreton Gardens, S.W.5. The greater part of the report is devoted to an appendix containing a bibliography of books on civics. About 12 pages are occupied by this list, which mentions altogether about 400 books, pamphlets, and magazine articles. It was found impossible and undesirable to include all books bearing on the subject; there can be no doubt, however, that any serious student with this list in hand could rapidly make himself familiar with the various aspects of civics and the different points of view apparent in the treatment of the subject. As is natural, only publications of the last few years are, in general, mentioned. One suggestion, of special interest to readers of NATURE perhaps, occurs after a study of the report: What would an anthropologist say to this vast literature of citizenship? He would, we judge, divide it into two classes: first, those writings in which citizenship is looked at as the natural course of life in a human community, and in relation to the essentially simple occupations on which all human life is based; and, second, those in which chief place is given to current, and often unscientific, views of human life and organisation. The choice between those two types of book would be of importance not only in connexion with citizenship, but also in connexion with science-teaching.

THE jubilee of the University Extension movement will be celebrated this year at Cambridge, where it began under the leadership of Prof. James Stuart, of

Trinity College, in 1873. Delegates from all the universities of the Empire and many of those of the United States, as well as representatives of local lecture centres and tutorial classes and local education authorities, will be invited to attend a conference, to be opened on July 6 by Lord Balfour as Chancellor of the University, which will last until July 10. The annual summer meeting will be held at Oxford on July 27, when Sir Michael Sadler will deliver the inaugural lecture of a course on "Universities and their Place in National Life." The list of lecturers will include Prof. Clement Webb, Dr. Selbie, Canon Ollard, Principal Ernest Barker, Dr. Cranage, Dr. L. P. Jacks, Mr. Ramsay Muir, Sir Gregory Foster, Principal Childs, Mr. J. A. R. Marriott, Mr. Albert Mansbridge, Mr. J. R. M. Butler, and Miss Maude Royden, and probably Dean Rashdall, Prof. Rait, and Mr. Coulton. The subsidiary subject of study at the meeting will be "The Social and Economic Problems of English Country Life," introduced by Sir Daniel Hall. The following statistics are taken from annual reports for 1921–22 on University Extension work of the Universities of Oxford, Cambridge, and London, the figures for the several universities being given in the above order: number of courses, 121, 92, 144; enrolment, 12,000, 11,721, 12,431. Summer vacation courses are being organised this year by or in connexion with almost all the English universities, the University of Wales, and the University of Aberdeen. Holiday courses for foreigners will be provided at Cambridge and London.

THE results of a comprehensive investigation of the home-residence of university students in 1920–21, undertaken by the United States Bureau of Education, have been tabulated in Bulletin, 1922, No. 18. On an average, one-fourth of the students in the universities and colleges of a State came from outside the State and 1½ per cent. came from foreign countries. Of these 6900 foreigners, Asia contributed 2506, North America 2156, Europe 1379, South America 563, Africa 223, Australia 61, China 1443, Canada 1294, Japan 525, West Indies 396, Russia 291, Mexico 282, India 235, Central America 184, France 160, Great Britain 149, South Africa 141, Brazil 126, Norway 94. From United States possessions (chiefly the Philippines, Hawaii, and Porto Rico) there were 1456 students. The returns published by the University Grants Committee for the same year show that of full-time students in universities and university colleges in Great Britain in receipt of treasury grant (but excluding Oxford, Cambridge, Guy's Hospital Medical School, and Trinity College, Dublin), 42 per cent. came from places beyond 30 miles from the institution, 6·2 per cent. from beyond the United Kingdom, and 1·7 per cent. from foreign countries. Turning to the Universities Yearbook, 1922, we find the percentage of students from outside the United Kingdom was 8, the difference being due to including returns from Oxford, Cambridge, Dublin, and Guy's: Asia contributed 1576, America 781, Europe 645, Africa 1187, the Pacific 281, China 143, Canada 200, Japan 73, West Indies 101, Russia 91, India 1240, France 62, U.S.A. 400, South Africa 832. Similar statistics in the Swiss *Bulletin Universitaire* of November last show that of students attending the seven Swiss universities in 1922, 20 per cent. were foreigners, the proportion being highest in Fribourg, Geneva, and Lausanne; at the Federal Polytechnic, Zurich, the proportion was 16.

IN view of the recent recommendation of the Board of Education's Consultative Committee that more attention should be paid in secondary schools to the cultivation of music and that this subject should be given full recognition in the first and second school certificate examinations, the report recently published by the United States Bureau of Education (Bulletin, 1921, No. 9) on the "Present Status of Music Instruction in Colleges and High Schools" is of interest to teachers and others in this country. It appears that nearly half of the universities and colleges in America allow entrance credit in musical theory and more than one-third in "appreciation," including history, form, and so on. Recognition of applied music for entrance qualification is a matter of very recent development, but already in 1919 more than one-sixth of these institutions allowed entrance credit in piano, violin, etc., and half as many recognised performances in orchestra, glee-clubs, and chorus singing. In 25 per cent. credit for applied music is allowed toward the B.A. or B.Sc. degree. In general it may be said that there is ample evidence of increasing interest in the development of music as a social, cultural, and professional subject in the universities and colleges. The same may be said of the high schools, where orchestra is becoming an increasingly important feature of school life and courses in harmony and appreciation are often provided. The report does not distinguish between boys and girls except as regards glee-singing, of which there appear to be almost as many boys' as girls' courses. The fact that credit toward school leaving certificates is granted in a large proportion of the schools offering music courses seems to indicate that there is an effort to present these courses in a manner sufficiently thorough to make them compare in requirement with the other courses of the high school.

AN American criticism of higher education in Australia and New Zealand has been published by the United States Bureau of Education in Bulletin, 1922, No. 25. It is based on a visit to Australasia in 1920 by Dr. C. F. Thwing, president emeritus of Western Reserve University and author of "Universities of the World" (Macmillan, N.Y., 1911). Among other differences between American and Australian universities Dr. Thwing notes that whereas one half or more of American undergraduates look forward to a business career, most of those in Australia are preparing for the professions and only a very few go into business: most of the engineering graduates enter the Federal Public Works departments. Training for the professions, while thorough in a practical sense, lacks generally the liberal foundation given in the American college. Dr. Thwing, who is interested chiefly in the sociological aspects of university questions, considers that notwithstanding the apparent success of the adult-education movement in the universities, their influence on the community is slight and there is a tendency for their members to confine themselves to their special work and avoid all public responsibility. He believes that in the presentation of many subjects, such as government and economics, teachers are liable to be hampered by the fact that the university depends for grants for its support on a government which is often controlled by doctrinaire leaders of the so-called working classes. Until recent years no chair of economics was established in any university, although education for citizenship should have been one of the principal services of the university to a community in which there is a dearth of men of any great distinction in the political sphere, and parties are generally content with negative cries. While Dr. Thwing was gathering materials for his account of Australasian universities, Prof. E. R. Holme, of Sydney, happened to be similarly engaged in studying higher education in America and preparing his book on "The American University."

Societies and Academies.

LONDON.

Royal Society, February 22.—G. I. **Taylor** and C. F. **Elam**: The distortion of an aluminium crystal during a tensile test (Bakerian lecture). A rectangular specimen 1×1×20 cm. cut from a round bar of aluminium, which had been treated by the method of Carpenter and Elam, so that it consisted of one single crystal, was stretched through successive extensions of 0, 10, 20, 30, 40, 60, and 78 per cent. of the original length. At each stage of the test, distortion was determined by measurements of scratches ruled on the surface and the directions of the crystal axes were determined by X-ray analysis. The method for determining the nature of the distortion was to find lines of particles which were unextended by the strain. The directions of these lines lie on a quadric cone, which evidently has two positions corresponding with the two configurations from which it was derived. It was found that, up to 40 per cent. elongation, the "unextended cone" was of a degenerate form consisting of two planes, one of which contained in all cases the same particles, while the other contained different particles for different strains. Distortion was due to slipping or shearing over the former plane. By X-ray measurements it was found that the slip plane was identical with an octahedral (III) plane of the crystal. The direction of the shear was along one of the three principal lines of atoms in the octahedral plane. When the specimen was extended beyond 40 per cent. elongation, the effect of the shear was to rotate the axis of the specimen relative to the crystal axes in such a way that another (III) plane came into a position where its inclination to the axis was the same as that of the slip plane. In these circumstances slipping might occur on both planes simultaneously.

Aristotelian Society, February 5.—Prof. A. N. Whitehead, president, in the chair.—May **Sinclair**: Primary and secondary consciousness. Consciousness is defined as a state of awareness, of knowing that there is something "there." Idealism regards the world as arising in consciousness; realism regards it as existing apart from and independent of consciousness. Primary consciousness is all that is present to the subject in perception, contemplation, memory, and immediate thinking, before reflection, judgment, and reasoning has set in. It says nothing about the external and independent existence of its content or object. Secondary consciousness is consciousness of consciousness. It is all reflection, judgment, reasoning, all the play of mind round and about its object. Secondary consciousness is always distinguishable from its object and primary consciousness is not. Therefore secondary consciousness alone supports the realist's assumption and provides the basis for his attack. At the point where consciousness is most vivid, most intense, its identity with its object is absolute: as in the consciousness of a lightning flash, of shell-fire, or toothache. Here there is no possibility of analysing into consciousness and independent object. Yet at this point primary consciousness is the intensest affirmation of its object's existence. There is no reason why this should be so if realism were true. We cannot then distinguish between consciousness and its object. When we seem to be doing this we are really distinguishing between primary and secondary consciousness, and the distinction falls within consciousness. Implicit judgments of perception present a difficulty. They would seem to be primary. But all explicit judgments are clearly secondary. The realist judgment is of this nature and it comes too late to save the independent reality of the object.

Royal Anthropological Institute, February 6.—Mr. H. J. E. Peake in the chair.—E. O. **Rutter**: The natives of British North Borneo. Fifty years ago the native population of North Borneo consisted of pirates, who ranged along the coasts, and of head-hunters, who lived in small communities in the hills. The natives may be divided into three groups—the people of the coast, the people of the plains, and the people of the hills. The coast natives are mainly Bajaus, Sulus, and Illanuns; they are Mohammedans and, for the most part, sea-gipsies. Boats take the place of caravans and they make their living from the produce of the sea. Even when they build houses they are usually constructed over the water upon the seashore or the river banks. Some are accomplished horsemen. The inhabitants of the plains are the Dusuns, a race of farmers, law-abiding and industrious, who cultivate the rice which is their staple food. Some of the Dusuns come into the hill group and with them are the Muruts. The latter are the most primitive race. They live in villages of one or perhaps two houses 200 or 300 feet in length, perched high upon a hill to be out of the way of raiding-parties. Only within the last few years have they abandoned head-hunting, which was the outcome of feuds between villages. Peace terms were sealed by bathing in the blood of buffaloes and planting stones as witnesses of oaths of peace.

Linnean Society, February 15.—Dr. A. Smith Woodward, president, in the chair.—A. M. **Alston**: On the method of oviposition and the egg of the beetle *Lyctus brunneus* Steph.—V. S. **Summerhayes**: Lichens collected by the Oxford University Expedition to Spitsbergen in 1921. In all, 68 species in 27 genera of lichers were found, chiefly on Bear Island, a mass of limestone rock, and Prince Charles's Foreland, of siliceous rock.—F. Howard **Lancum**: Curious oviposition by a specimen of the clouded yellow butterfly, *Colias edusa*. A female *Colias edusa* refused to deposit ova and declined to feed. At the end of a fortnight it was transferred casually to a leaf of a potted plant of white clover, and it laid one egg, and by moving it seventeen times in succession to different leaves, seventeen eggs were obtained. It was curious that it would not deposit an egg until it was moved.—B. Daydon **Jackson**: C. A. Agardh's "Aphorismi botanici," Lundæ, 1817–26, 8°. The volume confirms the practice prevalent in Scandinavia to the middle of the previous century, the Præses being the actual author, and the Respondentes being little better than dummies.

Royal Meteorological Society, February 21.—Dr. C. Chree, president, in the chair.—E. **Gold**: A proposed reform of the calendar by Dr. C. F. Marvin, Chief of the U.S. Weather Bureau. Dr. Marvin in his pamphlet states that the only modification of the Gregorian calendar which meets the need of the meteorologist is one which calendars the year in exactly 13 months of 28 days each, each of which would start on a Sunday. One day in each year and an additional day in leap year, should be set apart as public holidays.—S. **Fujiwhara**: (1) On the growth and decay of vortical systems. Water vortices of a like sense of rotation attract, and vortices of opposite sense repel each other. Vortices grow by amalgamation, and cyclones and anticyclones can be regarded as following similar laws. The

equation of growth of energy of vortices is similar to the equation for vital growth given by Brailsford Robertson. (2) On the mechanism of extratropical cyclones. From the equation for change with time of the vorticity of horizontal motion in the earth's atmosphere devised by Hesselberg and Friedmann, the most important source of energy of a cyclone is in the vorticity of the surrounding field. The feeding of a cyclone along the steering surface (of the Polar Front theory) is capable of explanation as the absorption by the main whirl of the horizontal whirl which forms at the surface.

EDINBURGH.

Royal Society, February 5.—Prof. F. O. Bower, president, in the chair.—A. G. **Ogilvie**: Physiography of the Moray Firth coast. The coastal features along the Moray Firth from Golspie to Inverness, thence east to Port Gordon, were described. The Firth seems to occupy the site of a foundered crustal block, bounded by known fractures on the north-west, and by possible faults on the south side. Four marine platforms occur there, but the detailed levelling shows that the inland margin of the highest beach is never above ninety feet. Some of the flat expanses of gravel and sand, hitherto regarded as remnants of this terrace, seem to be outwash aprons from the retreating glaciers. Special attention was directed to the constructive action of the sea in originating shingle bars and sand bars, which unite to form forelands and strand plains.

CAMBRIDGE.

Philosophical Society, February 5.—Mr. C. T. Heycock, president, in the chair.—E. A. **Milne**: The escape of molecules from an atmosphere, with special reference to the boundary of a gaseous star.—J. E. **Jones**: Free paths in a non-uniform rarefied gas with an application to the escape of molecules from an isothermal atmosphere. In a gas such as exists at the outer fringes of an atmosphere the usual formulæ of the kinetic theory for the calculation of free paths are no longer applicable. The necessary generalisations have been applied to find the condition under which a molecule may escape from an atmosphere. The total number of molecules lost in this way has then been enumerated by a more detailed method than has been used hitherto.—J. S. **Rogers**: L series of tungsten and platinum.—R. H. **Fowler**: Contributions to the theory of α-particle phenomena. Pt. I. Stopping powers. Pt. II. Ionisation.—C. G. F. **James**: The representation of varieties in space of three and four dimensions.—M. J. M. **Hill**: On the fifth book of Euclid's elements.—G. H. **Hardy**: A chapter from the notebook of Mr. Ramanujan.—E. C. **Titchmarsh**: Hankel transforms.—J. P. **Gabbatt**: A generalisation of Feuerbach's theorem.

PARIS.

Academy of Sciences, February 5.—M. Albin Haller in the chair.—G. **Bigourdan**: The "Cabinet du Roi" and the forgotten discoveries of Rochon. An historical account of the installation of this observatory in 1761, its equipment and an account of the astronomical work done there by Noël, Leroy, and Rochon.—Charles **Richet**, L. **Garrelon**, and D. **Santenoise**: The laryngo-cardiac reflex.—A. **Blondel**: Influence of the speed governors controlling turbo-alternators on the oscillations of the electrically connected sets. Case of indirect regulation.—R. de **Forcrand**: The hydrates of krypton and argon. The dissociation pressures of these hydrates have been measured at varying temperatures and the heats of formation calculated from the results.—J. **Roudaire-Miégeville**: The grapho-mechanical determinations of systems of real or imaginary solutions of algebraical equations. A development of the work of Kempe and of Koenigs on tracing algebraic curves by an articulated system.—Charles **Fremont**: The cause of the formation of the elongation at constant load near the elastic limit in testing mild steels.—Th. **Moreux**: The probable cause of the anti-solar glow.—A. **Buhl**: The mass and electromagnetic fields of Th. De Donder.—Paul **Dienes**: Tensorial geometry.—J. **Haag**: The distribution of the molecules of a gaseous mass; application to the formula of Van der Waals.—Albert **Pérard**: Study of some neon radiations with the view of their applications to metrology. A comparison of the cadmium line (508·582 mμ) with five neon lines. The ratios of the cadmium and neon lines are not constant. The systematic variation proved that the neon lines were very close doubles.—L. **Bouchet**: Application of the plane-cylinder electrometer to the determination of the inductive capacities of solid substances.—R. **de Mallemann**: Determination of the electromagnetic double refraction of active liquids.—René **Ledrus**: The increase of dispersion in photo-electric X-ray spectra.—St. **Procopiu**: The arc spectra of metals in various media and in a vacuum. The metals studied were copper, gold, zinc, cadmium, magnesium, calcium, and aluminium, and the arcs were produced in air, hydrogen, coal gas, nitrogen, water, and in a vacuum. All the metals gave a stable arc in nitrogen, including magnesium, calcium, and aluminium, with which it is difficult to maintain an arc in air. Stable arcs were also produced in a vacuum. Details are given of the change produced in the lines.—P. **Dejean**: Correlation between the hypothesis of the elementary demagnetising field and the theory of the molecular field.—E. **Darmois** and J. **Périn**: Dextro malic acid and the utilisation of ammonium molybdomalate for the resolution of racemic malic acid. The dextrorotatory malic acid prepared by Walden's method is partially racemised, and it contains about ¾ dextrorotatory acid and ¼ lævorotatory acid. By conversion into ammonium dimolybdomalate a separation can be effected.—G. **Claude**: The application of coke oven gas to the synthesis of ammonia. After removal of benzol by oil and carbon dioxide by lime water, the remaining gases are separated by fractional condensation, the hydrogen passing on to the ammonia apparatus.—Raymond **Delaby**: The characterisation of the alkylglycerols.—Léon **Bertrand** and Antonin **Lanquine**: Extension of the *duplicatures provençales* under the Cheiron layer (Alpes-Maritimes) to the west of the Var valley.—Filippo **Eredia**: The dryness of Italy during the year 1921.—E. and G. **Nicolas**: The influence of hexamethylene-tetramine and formaldehyde on the internal morphology and chemical changes in the bean.—A. **Polack**: The physiological determinism of the accommodative reflex of the eye.—J. **Dragoiu**, F. **Vlès**, and M. **Rose**: Cytological consequences of the lowering of the hydrogen ion concentration on the evolution of the egg of the sea-urchin.—A. **Goris** and P. **Costy**: The urease of fungi. The urease from *Boletus edulis* was studied: detailed accounts of the effects on the enzyme of heat, acids, alkalies, neutral salts, and antiseptics are given.—L. G. **Seurat**: The fauna of penetration of South Tunisian rivers.—R. **Herpin**: The sexual relations in *Perinereis cultrifera*—L. **Léger** and E. **Hesse**: A fungus of the Ichthyophonus type, a parasite of the intestine of the trout.

SYDNEY.

Royal Society of New South Wales, December 6.—Mr. C. A. Sussmilch, president, in the chair.—Miss Ida **Brown**: Notes on hornblende and bytownite from hypersthene gabbro, Black Bluff, near Broken Hill. A description of the separation of hornblende and plagioclase felspar from a gabbro which occurs about six miles to the south-east of Broken Hill, and a discussion of their chemical composition and optical properties.—H. G. **Smith** and J. **Read**: The glucoside occurring in the timber of the red ash, *Alphitonia excelsa*, Reiss. The red colour of this timber is due to the oxidation, upon exposure to light and air, of a characteristic constituent, which shows a marked resemblance to fustin, the glucoside of young fustic, *Rhus cotinus*. The substance sometimes occurs as a chalky deposit in the cracks and shakes of the timber, and it may also be extracted from the wood shavings with boiling water. It melts at 218-219°, and is probably identical with the glucoside of *Rhodosphacra rhodanthema*, having the formula $C_{36}H_{30}O_{16}$. It forms a mono-potassium salt, and a corresponding ammonium salt. It is hydrolysed with extreme difficulty by boiling dilute acids.—A. R. **Penfold** and R. **Grant**: The economic utilisation of the residues from the steam rectification of the essential oil of *Eucalyptus cneorifolia* and the germicidal values of the crude oil and the pure active constituents. The dark-coloured waste product contains 6·5 per cent. australol (phenol) and 25 per cent. aromatic aldehydes, principally cryptal, the remainder being sesquiterpenes, etc. The active constituents when tested by the Rideal-Walker method have high germicidal values. The crude oil when emulsified with rosin soap has a coefficient of 6·5, and forms a cheap and powerful disinfectant.—A. R. **Penfold** and F. R. **Morrison**: The essential oil of *Eriostemon Crowei* (*Crowea saligna*). This tall shrub, found on the rocky sloping banks of creeks and rivers in the Sydney district, yielded 0·4 of an oil heavier than water; the principal constituent (90 per cent.) was a new phenol ether, for which the name "croweacin" is proposed. Its molecular formula is $C_{11}H_{12}O_3$, and it contains one methoxy group. On oxidation with potassium permanganate it yields a neutral body, $C_{11}H_{14}O_5$, of M.P. 93° C., and an acid, $C_9H_8O_5$, of M.P. 153° C.—M. B. **Welch**: A method of identification of some hardwoods. In search of an accurate method of identifying certain hardwood timbers, particularly the Eucalypts, extracts obtained by boiling a definite weight of shavings in a known volume of water were examined. Various reagents, such as ferric chloride, lime-water, etc., were added to the extract, and a comparison made between similar timbers. The method does not give results with certainty.—M. B. **Welch**: The resinous exudation of rosewood. The resinous exudation or "sweating" which destroys the polish of rosewood is due to numerous minute drops of oil in certain parts of the wood. A steam distillation of shavings gave a yield of more than 3 per cent. of a bluish-coloured oil. Sweating is apparently due to lack of seasoning, or to polishing a freshly prepared surface.—W. S. **Dun** and Sir Edgeworth **David**: Notes on the occurrence of Gastrioceras, at the Irwin River Coalfield, W.A., and a comparison with the so-called Paralegoceras from Letti, Dutch East Indies. *Gastrioceras Jacksoni* occur in the Gascoyne River district, W.A., in a very well-marked horizon in the Lower Marine Permian beds, which has been traced for more than 20 miles. A new form is identical with Haniel's *Paralegoceras sundaicum* from the Permian of the Island of Letti. This is associated with a brachiopod fauna of a definite Asiatic Permian facies, and it will thus be possible to attempt a more definite correlation of the Western Australian beds with the Permian of Asia and Eastern Europe.—W. R. **Browne** and W. A. **Greig**: On an olivine-bearing quartz-monzonite from Kiandra, N.S.W. An explanation of the very rare association of the two minerals olivine and quartz in the same igneous rock. The chemical composition of the rock is given.—W. R. **Browne**: Note on the occurrence of calcite in a basalt from the Maitland district, N.S.W. An account of a basalt containing about 15 per cent. of interstitial calcite, which is believed to be the result, not of surface alteration, but of deposition from magmatic waters during the crystallisation of the rock.—J. K. **Murray**: Notes on the bacteriological aspect of pasteurisation of milk for cheddar cheese-making. Pasteurisation, coupled with the use of a good starter, greatly favours those bacteria which produce a cheese of good flavour and aroma. The "pasteurised" cheese was better in flavour and aroma than the "raw" check cheese and did not markedly lose in texture or body. Its vitamin content is not considered to be in any marked degree different from that of the ordinary "raw" cheese.

MELBOURNE.

Royal Society of Victoria, December 14.—Mr. F. Wisewould, president, in the chair.—F. **Chapman** and I. **Crespin**: The Austral Rhynchonellacea of the "nigricans series" with a description of the new genus Tegulorhynchia. The forms of the "nigricans series," fossil and recent, in the southern hemisphere, which have been referred to the boreal genus Hemithyris, constitute a distinct zoological group Tegulorhynchia. The Cainozoic species of Tegulorhynchia have probably evolved from a Jurassic form like that of Burmirhynchia, without the intervention of the Cyclothyris type, which was so predominant in the Cretaceous of Europe. The direct line of descent is probably from the European type *Burmirhynchia variabilis*. The bathymetrical distribution of the forms living in southern waters has been found to be of value in comparing the stratigraphical characters of the fossil series.—J. R. **Tovey** and P. F. **Morris**: Contributions from the national Herbarium of Victoria, No. 3. The paper contains a description of a new species, *Kunyea sulphurea* Tovey and Morris, from West Australia, and records of new regional distribution of native and introduced plants. A new introduction, *Tradescantia fluminensis* Vell. (Water Spiderwort), is recorded and also some additions to the introduced flora of Coode Island.—H. S. **Baird**: The occipital bones of the Dipnoi. Sections of the exoccipital bone of Ceratodus, and comparison with a developmental series of Lepidosiren, show no evidence of endochondral ossification. It appears probable that the endochondral method of ossification—a phylogenetically more highly developed mode of bone formation—does not exist in the Dipnoi.—G. **Horne**: Aboriginal cylindro-conical stones. Cylindro-conical stones are found in the Darling district and West to L. Eyre. They are unknown by the Darling blacks; also by all except a few old men of L. Eyre tribes. These call them uncanny, being the petrified penis of one circumcised with a firestick before the moora introduced the knife. Afterwards the stones must be lost. Circumcision was unknown where the stones most abound.

Official Publications Received.

Académie des Sciences (Česká Akademie Věd a Uměni). Bulletin International. Résumés des travaux présentés. Classe des Sciences mathématiques, naturelles et de la Médecine. 18e année (1913). Pp. iii +397. 19e année (1914). Pp. iv+415. 20e année (1916). Pp. iii+408 21e année (1917). Pp. iv+408. 22e année (1920). Pp. iv+225. (Prague.

Diary of Societies.

SATURDAY, MARCH 3.

ASSOCIATION OF TECHNICAL INSTITUTIONS (Annual General Meeting) (at Carpenters' Hall), at 11 and 2.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir Ernest Rutherford: Atomic Projectiles and their Properties (3).

GILBERT WHITE FELLOWSHIP (at 6 Queen Square, W.C.1), at 3.—Dame Helen Gwynne-Vaughan: The Mechanism of Inheritance.

MONDAY, MARCH 5.

ROYAL ASTRONOMICAL SOCIETY (Geophysical Discussion), at 5.—The Absolute Measurement of Magnetic Force. Chairman, Dr. C. Chree. Speakers: F. E. Smith, Sir Arthur Schuster, H. Spencer Jones (and possibly Dr. A. Crichton Mitchell).

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

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: Man's Posture: its Evolution and Disorders (1) (Hunterian Lectures).

SOCIETY OF ENGINEERS, INC. (at Geological Society), at 5.30.—A. S. E. Ackermann: The Physical Properties of Clay (fifth paper) and the Dynamics of Pile-driving.

INSTITUTION OF RUBBER INDUSTRY (at Engineers' Club, 39 Coventry Street), at 6.30.—H. Savage: Telegraph Cable Manufacture, Rubber and Gutta-percha.

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7.—J. H. Parker and others: Discussion on Control in Industry.

ARISTOTELIAN SOCIETY (at University of London Club), at 8.—E. S. Russell: Psycho-biology.

ROYAL SOCIETY OF ARTS, at 8.—J. E. Sears: Length Measurement (1) (Cantor Lectures).

SOCIETY OF CHEMICAL INDUSTRY (London Section) (at Engineers' Club, 39 Coventry Street), at 8.—Dr. T. M. Legge: Industrial Poisoning and the Works Chemist.

TUESDAY, MARCH 6.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir Arthur E. Shipley: Life and its Rhythms (2). Rhythm in Living Organism.

ROYAL SOCIETY OF ARTS (Dominions and Colonies Section), at 4.30.—Major E. A. Belcher: The Dominion and Colonial Sections of the British Empire Exhibition.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. G. Evans: The Nature of Arterio-sclerosis (1) (Goulstonian Lectures).

ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—H. G. Cannon: A Note on the Zoœa of the Land-Crab, *Cardisoma armatum*.—Miss L. E. Cheesman: Notes on the Pairing of the Land-Crab, *Cardisoma armatum*.—Dr. C. F. Sonntag: The Comparative Anatomy of Tongues of the Mammalia. VIII. Carnivora.—R. Kirkpatrick: A New Species of the Tunicate *Rhizomolgula* with remarkable Sensory Organs. No. 24. Results of the Oxford University Expedition to Spitsbergen, 1921.—T. H. Ring: The Elephant-Seals of Kerguelen Island.

INSTITUTION OF CIVIL ENGINEERS, at 6.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Scientific and Technical Group), at 7.—K. C. D. Hickman: An Electric Indicator for Washing-troughs.—A. C. Banfield: The "Perfect" Camera.

RÖNTGEN SOCIETY (at Institution of Electrical Engineers), at 8.15.

WEDNESDAY, MARCH 7.

INSTITUTE OF METALS (at Institution of Mechanical Engineers), at 10.—Dr. Aitchison: The Mechanical Properties of the Magnesium Alloys.—Prof. H. C. H. Carpenter and C. C. Smith: Tests on Work-hardened Aluminium Sheet.—Kathleen E. Bingham and Dr. J. L. Haughton: The Constitution of some Alloys of Aluminium with Copper and Nickel.—M. Cook: The Recrystallisation of Cold Worked Cadmium.—Dr. A. W. Gray: Volume Changes accompanying Solution, Chemical Combination, and Crystallisation in Amalgams.—At 2.30.—Dr. W. Rosenhain, S. L. Archbutt, and S. A. E. Wells: The Production and Heat-Treatment of Chill Castings in an Aluminium Alloy ("Y").—Prof. F. C. Lea, Dr. V. A. Collins, and Dr. E. A. F. Reeve: The Modulus of Direct Elasticity of Cold-drawn Metals as a Function of Annealing Temperature.—A. M. Portevin: The Structure of Eutectics.—R. Genders: The Extrusion Defect in Brass Rods extruded from a Multiple Die.—S. Beckinsale: Further Studies in Season-Cracking and its Prevention. The Removal of Internal Stress in 60:40 Brass.

ROYAL SOCIETY FOR THE PROTECTION OF BIRDS (at the Middlesex Guild-hall, Westminster), at 3.—Annual Meeting.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: Man's Posture: its Evolution and Disorders (2) (Hunterian Lectures).

INSTITUTION OF ELECTRICAL ENGINEERS (Wireless Section), at 6.—H. Morris-Airey: Development of Naval High Power Valves.

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS (at Chemical Society), at 8.—A. Lucas: The Examination of Firearms and Projectiles.—R. C. Frederick: The Interpretation of the Results obtained in the Analysis of Potable Waters.—S. B. Phillips: Determination of the Purity of Vanillin.

ROYAL SOCIETY OF ARTS, at 8.—Prof. E. P. Stebbing: The Forests of Russia.

ENTOMOLOGICAL SOCIETY OF LONDON, at 8.

THURSDAY, MARCH 8.

INSTITUTE OF METALS (at Institution of Mechanical Engineers), at 10.—R. C. Reader: Some Properties of the Copper-Rich Copper-Aluminium Alloys.—C. R. Austin and A. J. Murphy: The Ternary System Copper-Aluminium-Nickel.—Col. N. T. Belaiew: The Inner Structure of the Crystal Grain as revealed by Meteorites and Widmanstätten Figures.—A. L. Norbury: The Hardness of Annealed Copper.—A. L. Norbury: The Hardness of certain Copper Alpha-Solid Solutions.—At 2.30.—H. Heape: The Density and the Hardness of the Cast Alloys of Copper with Tin.—Dr. D. Hanson and Marie L. V. Gayler: The Heat-Treatment and Mechanical Properties of Alloys of Aluminium with Small Percentages of Copper.—Marie L. V. Gayler: The Constitution and Age-Hardening of the Ternary Alloys of Aluminium with Magnesium and Copper.—R. Genders: The Scleroscope Hardness Test. A New Form of Magnifier Hammer.—N. B. Pilling and R. E. Bedworth: The Oxidation of Metals at High Temperatures.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—T. Stevens: Water Power of the Empire (2).

ROYAL SOCIETY, at 4.30.—A. B. Wood, H. E. Browne, and C. Cochrane: Determination of Velocity of Explosion Waves in Sea Water. Variation of Velocity with Temperature.—P. M. S. Blackett: The Study of Forked Alpha Ray Tracks.—E. Hatschek and P. C. L. Thorne: Metal Sols in Non-dissociating Liquids. I. Nickel in Toluene and Benzene.—H. Hirata: Constitution of the X-Ray Spectra belonging to the L Series of the Elements.—A. Egerton: The Vapour Pressure of Lead. I.—A. C. Egerton and W. B. Lee: Some Density Determinations.—A. C. Egerton and W. B. Lee: Separation of Isotopes of Zinc.

LONDON MATHEMATICAL SOCIETY (at Royal Astronomical Society), at 5.—Prof. A. E. H. Love: Some Electrostatic Distributions in Two Dimensions.—J. P. Gabbatt: A Hyperspatial Analogue of Feuerbach's Theorem.—Prof. G. H. Hardy and E. C. Titchmarsh: Solutions of some Integral Equations considered by Bateman, Kapteyn, Milne, and Littlewood.—S. C. Dlar: Some Integral Equations connected with the Elliptic Cylinder Functions.—J. Vinogradow: Lattice Points in Regions of two or three Dimensions.—M. Merker: Génération et étude d'une surface du 3e ordre particulière.—H. W. Turnbull: The General Symbolic Notation for the Principle of Duality and its Application to Determinants.—E. W. Hobson: On Generalised Fourier Series.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. G. Evans: The Nature of Arterio-sclerosis (2) (Goulstonian Lectures).

ROYAL SOCIETY OF MEDICINE (Balneology and Climatology Section), at 5.30.—Dr. Sonntag and others: Discussion on The Vagus and Sympathetic Nerves and their Relation to Hydrology and Climate.

SOCIETY OF DYERS AND COLOURISTS (London Section) (at Dyers' Hall, Dowgate Hill), at 7.—B. Brown and H. Jordan: The Valuation of Dye-stuffs by Titration Methods. (Rapid Commercial Estimation of Value.)

OPTICAL SOCIETY (at Imperial College of Science and Technology), at 7.30.—H. Dennis Taylor: Optical Designing as an Art.—T. Smith: The Distribution of Correction Duties in Optical Instruments.

INSTITUTE OF METALS (London Local Section) (at Institute of Marine Engineers), at 8.—Open Discussion.

CAMERA CLUB, at 8.15.—H. Main: A Pilgrimage to Provence.

FRIDAY, MARCH 9.

ROYAL ASTRONOMICAL SOCIETY, at 5.

PHYSICAL SOCIETY OF LONDON (at Imperial College of Science and Technology), at 5.—Sir William Bragg: The Crystalline Structure of Anthracene.—Dr. A. B. Wood and Capt. H. E. Browne: A Radio-acoustic Method of locating Positions at Sea.—J. H. Powell and Dr. J. H. T. Roberts: The Frequency of Vibration of Circular Diaphragms.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: Man's Posture: its Condition and Disorders (3) (Hunterian Lectures).

MALACOLOGICAL SOCIETY OF LONDON (at Linnean Society of London), at 6.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (at Engineers' Club), at 7.—J. G. Clark: Gas as a Fuel.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—R. C. D. Fell: Rolling Mill Machinery.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 8.—W. Sanderson: Over the Gemmi to the Valley of the Rhone.

INSTITUTE OF CHEMISTRY at 8.—E. J. MacGillivray: Some Aspects of the Law of England affecting Chemists.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Dr. C. W. Saleeby: Sunlight and Disease.

SATURDAY, MARCH 10.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir Ernest Rutherford: Atomic Projectiles and their Properties (4).

GILBERT WHITE FELLOWSHIP (at 6 Queen Square, W.C.1), at 3—Conversazione.

PUBLIC LECTURES.

SATURDAY, MARCH 3.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Miss M. A. Murray: Legends of the Gods of Ancient Egypt.

MONDAY, MARCH 5.

VICTORIA LEAGUE HOUSE (22 Eccleston Square, S.W.1), at 5.—P. D. Warren: Peeps at Ceylon Life, Industries, and Vegetation.

OVERSEAS CLUB AND LEAGUE (at Vernon House, Park Place, S.W.1), at 8.—W. R. Dunlop: The Work and Aims of the West Indian Agricultural College, Trinidad.

TUESDAY, MARCH 6.

LONDON SCHOOL OF ECONOMICS, at 5.—A. W. Flux: Statistics, before, during, and after the War: Prices.

SCHOOL OF ORIENTAL STUDIES, at 5.—Sir E. Denison Ross: Early European Intercourse with the East.

WEDNESDAY, MARCH 7.

UNIVERSITY COLLEGE, at 5.—Dr. A. H. Drew: The Cultivation of Tissues in Vitro (2). (Succeeding Lecture on March 14.)

KING'S COLLEGE, at 5.—Sir Herbert Jackson: Some Thoughts on the Relations of Science and Industry.

THURSDAY, MARCH 8.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 5.—W. Bayes: Painting and Architecture.

SATURDAY, MARCH 10.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—H. N. Milligan: The Great Sea-serpent.