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The Function of English in Scientific Education.

THE Report of Mr. Fisher's Committee on the Teaching of English in England (pp. 394, H.M.S.O., 1921, 1*s.* 6*d.* net) has a refreshing novelty of outlook. As the serious study of English in the schools has an even shorter history than that of science, this Committee is little affected by pedagogic prejudices and vested interests, so that it is bold enough to treat all subjects taught in schools as coming within one or other of two groups, English and Science.

This classification calls for wide definitions; it is laid down that "in school, science must be, for teacher and for student, the methodical pursuit of truth and the conquest of the physical world by human intelligence and skill." The term "English" has in the past been interpreted in many ways. The public-school master of thirty or forty years ago would think of it as connoting geography, the history of England, and a little analysis and parsing, syntax and accidence. The Committee's definition is very different; it does not concern itself primarily with history or geography or with the study of language, but with the English language as a means of communication, oral and written, and with the content of books written in English as a storehouse of ideas, whether native or translated, and as an agent of emotional and æsthetic culture. Thus education is divided into "the training of the will (morals), the training of the intellect (science), and the training of the emotions (expression or creative art)," corresponding to the view that "the three main motives which actuate the human spirit are the love of goodness, the love of truth, and the love of beauty."

A separation of function of this kind has some value, if only to make us realise the necessity of each of the different components of a complete education. In practice, however, any one subject of study can and does perform several functions, overlapping those of other subjects which are akin to it. Thus some aspects of the study of English are of essential utilitarian value to a man of science, such as training in the power to write or speak clearly, lucidly, without ambiguity or prolixity, and if possible with a sense of style such that the reader may be attracted as well as instructed. But this power cannot be developed in the student without traversing much of the same ground as would be covered if the chief aim were the development of other faculties. So there will be economy of time and effort if English is used as the vehicle for an education in the humanities. It is universally agreed that, even for full efficiency in his own department, the science specialist must have such an education; it is the chief concern of the Committee to show how completely English can be made to fulfil that function.

The Committee mentions with approval the methods which have been developed at Osborne and Dartmouth in the training of naval cadets for their future career, which may be regarded as predominantly scientific, but in which they will need all the faculties of a liberally educated mind and character. For they may have to be diplomatists, tacticians, and strategists, and must certainly be leaders of men no less than practical scientific workers; they must be equipped for controlling minds as well as machines. This problem is not peculiar to the Navy, though perhaps it is more obvious there owing to the close contact, under one controlling authority, between those who train and those who employ the product of the naval college, a contact closer than is practicable, for example, between schoolmasters and leaders in the business world. Hence the experience of Dartmouth may be of more than local interest.

It says much for the prescience of the Admiralty that it should have committed itself, so far back as 1903, on the advice of the eminent man of science, Sir Alfred Ewing, who was then Director of Naval Education, to the faith that, given adequate time and skilled treatment, most of the values hitherto judged to accrue solely from a classical education were to be derived from the study of English. The experience gained during the past eighteen years in acting on this belief has gone far to justify it, and it is satisfactory to note that the methods which have been elaborated are in close

agreement, both in principle and detail, with those recommended by the present Committee.

There is little necessary connection between the study of the humanities and the teaching of languages; the latter properly falls under the head of a science, and the traditional connection arises from both having formerly been the province of one group of men. Before the days of the conflict of studies, the time devoted to Latin and Greek was far greater than was needed for the languages themselves, and the remainder was well spent on Literæ Humaniores. The present Report deals admirably with the question of the scientific and grammatical study of language; sections 254 to 266 are well worth reading in their entirety; but we are not concerned at the moment with the training of language specialists; we are, however, deeply interested in the problem of transferring to the teacher of English the functions formerly performed by the classics master in connection with the humanities. The first requisite for this transfer is to provide teachers adequately cultured; the next is to ensure the right use by them of the material available.

The Committee, therefore, had to decide what are the right methods of teaching; it also had to consider what modifications in these methods are appropriate to public elementary and preparatory schools, continuation, commercial, and technical schools, teachers' training colleges, and the universities; in addition, it felt constrained to prove that too little importance at present attaches to the study of English in all these institutions. Hence the Report covers so much ground that some search is needed to discover the teaching methods advocated.

A few extracts may, however, give some idea of the Committee's views. In commending recent progress it says:

"Exercises in both descriptive and imaginative writing, as well as practice in verse composition, in letter writing, and in dialogue, are common in the early stages. Many interesting experiments have been tried with a view to encouraging self-expression. These include debates, improvised dialogues, and dramatic scenes, and ten-minute lectures by pupils, in class as well as in out-of-school hours." "There is a far wider range of reading than formerly. . . . Rapid and enjoyable reading is no longer an exceptional thing; the class themselves take more part in the lesson and express their likes and dislikes freely." . . . "Not less important than the art of writing is the art of speaking, which includes practice not only in framing questions and answers, but also in reading aloud, recitation, debating, and drama." "A reasonable study of phonetics by the teacher should enable him to give guidance and to correct some of the most common and jarring mistakes of pronunciation." "The rendering of literature by the voice is not a mere matter of mechanical correctness, but is the final result of sympathetic entry into the spirit of the writer, and without it no education in letters can be complete."

The interest in lessons on such lines need never flag; but a note of warning is sounded. Since the reading and writing of English have an intimate and personal touch for the Englishman, they form a perfect medium for a humane education, but there is a possibility that an enthusiast may press this advantage too far and thrust himself unbidden into an inner sanctuary of the adolescent soul. It is significant that the Committee has received warning of this danger from headmasters of public schools, and not from other teachers, for a man who works in boarding-schools is apt to know more of the real boy and his reticences than the master in a day school. Hesitation on these grounds differs fundamentally from the objections of the conservative teacher whose sense of the ludicrous is stimulated by the thought of his class criticising a great author or acting scenes from a play, or of the disciplinarian who prefers the rigidity of dullness to the apparent disorder of a vividly interested class, or even of the man who feels that literature would be spoiled for the student by being read in school; but the Committee is probably right in holding that the danger is not great, and that in any event the gain is worth the danger.

In fine, to discover a medium of education in the humanities which is applicable to all sorts and conditions of Englishmen has been a vexed problem for many years, and the Committee has made an excellent case for leading us from the Abana and Pharpar of the classics to wash in the Jordan of English in order to secure a healthy and truly national system of education.

Calcium Carbide and the Board of Trade

What's a Word Worth?

"'The question is,' said Alice, 'whether you *can* make words mean so many different things.'

"'The question is,' said Humpty Dumpty, 'which is to be master—that's all.'"

IT is written: "A rose by any other name would smell as sweet"; perhaps, yet there are occasions when a name may be costly to play with. One of these occurred recently, an amount running into thousands of pounds having, it is said, changed hands in the effort to disestablish the meaning of a name. Called upon to interpret the Act, christened by our Legislature the Safeguarding of Industries Act but more appropriately described as an Act for

"The Sterilisation of Scientific Inquiry, the Retardation of Industry and the Stay of Progress in Education," an Act which penalises all our scientific workers, the lawyers have been disputing over the term *Chemical* and have practically decided that it has no meaning. They have toyed with the doublet *Organic Chemical* and their dialectics have landed them in the conclusion that chemists do not in the least know where they are—so they proceed to tell them where they are not. The decisions read like those given in Wonderland, being on strictly "Humpty Dumpty" lines; they are akin to his famous reading of "*toves*":

"Well, '*toves*' are something like badgers—they're something like lizards—and they're something like corkscrews."

Now a wrangle is on over *Fine Chemical*, a term that has never been defined and is indefinable.

According to the Schedule to the Act, protection is given to "All synthetic organic chemicals . . . analytical reagents, all other fine chemicals and chemicals manufactured by fermentation processes."

The Board of Trade, putting its own interpretation upon these words, has produced a very long list of dutiable chemicals; but this is deemed so imperfect that several hundred applications have been lodged to amend it. One of the articles not on the list is Calcium Carbide and an inquiry has been held, at intervals lasting over many weeks, into the legitimacy of the claim that this substance is a synthetic organic chemical, to be ranked in the army of the protected.

An advocate learned in the law but without knowledge of chemistry, sitting unassisted by an expert assessor, after hearing many witnesses for and against, no one of whose testimony, it is obvious, could he well appraise, without attempting to deal with the adjective "synthetic," has pronounced that the carbide is not even an organic chemical.

Given such a tribunal, the issue is obviously a matter of chance; chemists would be equally unable to decide with justice in cases into which purely legal considerations entered. Still, the decision is a serious reflection upon the mental attitude of the chemist—upon his failure to think and speak only in precise terms. Unfortunately the "Ignorance of the Learned"—Hazlitt's memorable phrase—is always with us.

Calcium carbide, as every motorist and most intelligent people to-day know, gives acetylene as sole gaseous product when water is dropped upon it, the hydrogen of the water being exchanged for the calcium of the acetylide (carbide) and *vice versa*. The synthesis of acetylene, from carbon and hydrogen at the temperature of the electric arc, was first effected in 1859 by Berthelot. That the distinguished French chemist had no doubt of the organic nature of the compound is clear from the fact that he describes the method in his "Chimie Organique fondée sur la Synthèse" and also in his "Leçons sur les Méthodes générales de Synthèse en Chimie Organique" (1864). Practically speaking, it is the fundamental synthesis of organic chemistry, the foundation upon which the vast series of constructive processes which render the science so remarkable has been developed.

If there be one word in use in chemistry which, after long dispute, has a defined and accepted meaning, it is the word "organic." The dispute began with Wöhler's discovery, in 1828, that urea—the organic compound which every human being voids daily in considerable quantity—could be made by a purely artificial process: the birth of synthetic organic chemistry is to be dated from that moment; structural chemistry became possible only after Frankland had introduced the conception of valency (1852). Then system began. The prince of systematists, Kekulé, in 1851, first defined Organic Chemistry as the Chemistry of the Carbon Compounds. Others followed him. When Schorlemmer, considerably later, suggested as the better definition —The Chemistry of the Hydrocarbons and their Derivatives—he took care to point out that "compounds containing one atom of carbon such as CO_2, $COCl_2$, CS_2, HCN, which are commonly described in the inorganic part, are as much derivatives of marsh gas, CH_4, the most simple hydrocarbon, as methyl alcohol and formic acid." In his "Rise and Development of Organic Chemistry," in discussing a series of organic syntheses, he makes special reference to that of acetylene and immediately afterwards remarks: "after this the synthesis of organic compounds made rapid progress."

What does it matter where the chemist may choose to describe a carbon compound, as a matter of convenience and policy, to-day? To put port into a lower instead of into an upper bin does not change the wine to sherry. No legal dialectics can depose a substance from its proper place in the chemist's system.

In fact, the decision of the Board of Trade Referee is an offence against both chemical tradition and our chemical conscience. Appeals, with reference to chemicals, under the Act, if they are to be heard justly, should be submitted to a tribunal of chemists learned in chemical science, not to an arbitrator only learned in the law, whose attitude can but be that of "Humpty Dumpty." H. E. A.

The Pioneer of Non-Euclidean Geometry.

Girolamo Saccheri's "Euclides Vindicatus." Edited and translated by G. B. Halsted. Pp. xxx + 246. (Chicago and London: The Open Court Publishing Co., 1920.) 10*s.* net.

THIS work is an important classic, which is well worthy of inclusion in the valuable series brought out by the Open Court Publishing Co.

Sir Henry Savile, in his lectures of 1620 on Euclid I., published at Oxford in 1621, had said that in his judgment there were two blemishes (*naevi*) or blots (*labes*), and no more, in the fair body of geometry, the first being the parallel-postulate, and the second the definition of "compound ratio" in Book VI. (a definition now known to be interpolated). Saccheri's "Euclides ab omni naevo vindicatus" dealt with both *naevi* in parts 1 and 2 respectively, and from the wording of his title we may fairly infer that it was the Englishman who gave the Italian Jesuit the motive for his epoch-making treatise—that of defending Euclid and proving (if he could) that Euclid's work contained *no* flaw. The present edition is confined to part 1, on the parallel-postulate, which is alone important. Saccheri must be called the pioneer of non-Euclidean geometry, for, although it was his object to establish the truth of the Euclidean postulate once for all by showing that all hypotheses other than that of Euclid are false, he was the first to contemplate the possibility of such other hypotheses and to follow them out to a number of consequences. He is therefore, as Beltrami observed, a true precursor of Legendre and Lobachewsky, and, it might be added, of Riemann also.

Saccheri starts with a quadrilateral formed by a given straight line as base, two perpendiculars of equal length erected from the extremities of the base on the same side of it, and the straight line joining the other extremities of the equal perpendiculars. The angles made by the latter straight line with the perpendiculars respectively are easily proved to be equal. There are then, says Saccheri, three possible suppositions—the two angles may both be (1) right angles (the Euclidean hypothesis), or (2) obtuse angles, or (3) acute angles. Saccheri calls these the hypothesis of the right angle, the hypothesis of the obtuse angle, and the hypothesis of the acute angle respectively, and the object of his treatise is to prove the absolute falsity of the last two hypotheses. His proof in the case of the obtuse angle depends on the universal validity of Euclid I. 16 (which excludes the Riemann hypothesis), while his proof in the case of the acute angle is even less successful. He nevertheless proves certain important propositions afterwards proved by Legendre, Lobachewsky, and Bolyai.

Saccheri lectured on philosophy and theology, as well as mathematics, and he wrote an important logical work, the "Logica demonstrativa," brought to light by Giovanni Vailati in 1903. He was otherwise an interesting personality. We are told that he had a passion for truth, and in his pursuit of it he would (like Archimedes) neglect his person, his food, his clothes, and his comforts. As a boy of five he was a calculating prodigy. Later he became a great chess-player, being able to play (and generally to win) three games simultaneously without seeing the boards, and, as if this were not enough, to talk to people around him and also to think out some abstruse geometrical problem at the same time; afterwards he would repeat all three games from memory.

Prof. Halsted has important qualifications for editing Saccheri's treatise. He is himself an authority on non-Euclidean geometry, and has an unbounded enthusiasm for his author, which we welcome even when it leads him to write such sentences as "So flowered the beauteous body of a new geometry, mermaid-like, the latter portions somewhat fishy, but, oh! the elegant torso." It is all the more unfortunate that his execution of his task proves in many respects disappointing. The introductory matter, mainly historical, is fairly adequate, but even here there are sins of omission and commission. When he says that Father Manganotti, S.J., "accidentally discovered" Saccheri in 1889, "re-discovered" would be a better word. For Saccheri's work was thoroughly examined in Klügel's dissertation, "Conatuum praecipuorum theoriam parallelarum demonstrandi recensio" (1763), certain details about it are given in Camerer's Euclid (vol. 1, 1824), C. F. A. Jacobi mentions it (1824), and it can scarcely have been unknown to Gauss and Lobachewsky.

On pp. xviii–xix Prof. Halsted pays the editor of "The Thirteen Books of Euclid's Elements" the compliment of quoting word for word (without inverted commas) a whole page from his description of Saccheri's "Logica demonstrativa." Almost in the same breath (p. i of preface) he charges the same editor with supposing that Saccheri's "Euclides ab omni naevo vindicatus" was a "Latin edition of Euclid," a baseless charge which he need not have made if he had read the other passages of the raided work where the editor gives not only a detailed description of the book now in question, but also three long citations of proofs by Saccheri of his own propositions with diagrams, which certainly never appeared in any "edition" of Euclid. Nor is there any excuse for Prof. Halsted's omission to mention the German translation of Saccheri in Engel and Stäckel's "Die

Theorie der Parallellinien von Euklid bis Gauss" (Leipzig, 1905), a better translation, and better annotated, than his own.

To come to the translation: Prof. Halsted quotes a remark by "one of the foremost classical scholars in America" that the Latin of Saccheri is almost classical and is remarkably clear. It is a pity that it should not have been translated into equally classical English. The translation is, in fact, the reverse, and it is clear that the translator was not well equipped for this part of his task. He seems imperfectly acquainted with the force of "quin," twice mistranslating it completely; apparently he does not know the meaning of "morem gerere," since he translates "ut morem gereret tot Magnis viris . . ." by "as made a custom with so many great men . . ." (!); he renders "in rem suam" by "in his affair" instead of "for his purpose," "superetur ab" by "would exceed" instead of "would be exceeded by," "liquet" by "it flows" instead of "it is clear," "dico . . . manifestae falsitatis redargui inimicam hypothesim" by "I say I have disproved the hostile hypothesis by a manifest falsity" instead of "I say I have convicted the hostile hypothesis of manifest falsity," "ad tuendas reliquas Definitiones" by "regarding other definitions" instead of "for the purpose of maintaining other definitions." He is habitually vague as to moods and tenses, commonly translating the subjunctive by the indicative, future by present, etc. And what are we to say of such a sentence as this: "But here (*vice versa*) in fact is permitted the designation of however most small an acute angle at the point A while still the sect AB to which is to be erected the indefinite perpendicular BX, may be taken of any length whatever"? The mathematician must make of this what he can. For our part, here and in many places, we find it a relief and comfort to be able to turn for light to the Latin on the opposite page.

The Structure of East Africa.

The Rift Valleys and Geology of East Africa. By Prof. J. W. Gregory (with ten appendices by various authors). Pp. 479+20 plates+5 maps. (London: Seeley, Service, and Co., Ltd., 1921.) 32*s.* net.

PROF. GREGORY is to be congratulated on having found, or made, opportunity to complete his work in East Africa, begun so brilliantly and adventurously in 1892–3. Returning to the country for a short visit in 1919, under favourable auspices and vastly improved conditions, he was able to collect much new information in rapid traverses, often by motor-car, where, as we are now reminded, on his previous journey his researches had been curtailed by the truculence of drunken warriors, or by drought, scarcity of game and ferocity of lions, or other such amenities of the old "safari" travel. Meanwhile there has been considerable exploration of this and neighbouring regions by other observers, and Prof. Gregory has essayed in the volume before us to combine what is known of the geology of East Africa into a coherent whole. That he has performed the task with courage and skill need scarcely be said; every scrap of information finds its appropriate place in his scheme and helps to consolidate it, so that we have a clear and logical account of the geological history of the region throughout the ages. All the rocks are classified into formations with local names and placed in position in the geological scale.

With the present meagreness of our knowledge of these vast spaces, there may seem to be a premature positiveness in the method of presentment, but the author defines his attitude explicitly in his preface: "Progress in East African geology requires a scheme by which new facts may be classified. The classification adopted is tentative and must be amended as well as amplified. Pioneer geology has to choose between the rashness of using imperfect evidence or the sterility of uncorrelated, unexplained facts." These sentences must be remembered by the reader; otherwise he may sometimes be startled at the big leap, taken with a bold "therefore," from the narrowness of the stated fact to the breadth of the deduction. Used in accordance with the author's suggestion, as an adjustable framework to accommodate new information, the book will be of particular service to every future worker in the same field, while to the geologist at large it provides the readiest means of gaining a general idea of the eastern portion of the African continent.

As implied by the title, Prof. Gregory's well-known and much-discussed conception of "the Great Rift Valley" runs as a leading theme throughout, and monopolises the shorter two of the four parts into which his book is divided. This is, however, largely a repetition, with some modification, of matter already published, here conveniently reassembled. It is parts 2 and 3, with the technical appendices, that constitute the major and most serviceable portion of the work.

In part 2, consisting of twenty-two chapters, the author describes the geology, mineral resources, etc., of British East Africa (now Kenya Colony). This part contains the details of the new observations made by the author in his recent traverses; hard reading for anyone unacquainted with the ground, but invaluable to the next investigators in exhibiting the evidence on which the generalisations and classi-

fications are based. The recently issued first Annual Report of the Geological Department of the Uganda Protectorate prepares us for future keen discussion on several points in the proposed classifications. Some notes on prehistoric man and on caves, water supply and soils, at the end of part 2, with further information in the appendices, are of general interest. The numerous geological sketch-maps and sections in the text, though effective in a broad way, are roughly drawn and poorly printed, so that the deciphering of their detail is often troublesome. Though unavoidable, the big exaggeration of the vertical scale in all the sections, with the consequent severe distortion of the slopes, should be constantly borne in mind, since it may profoundly affect the interpretation of the structures, particularly where questions of faulting are concerned.

In part 3 our present knowledge of the stratigraphy of the neighbouring countries of East Africa and of other regions supposed to be linked up with the "Great Rift" is usefully summarised in short chapters dealing successively with Uganda and the lakes, Tanganyika Territory, Nyasaland, Madagascar, Somaliland, and Abyssinia, with some reference also to the Nile Valley and Red Sea and to the Palestine trough. A full bibliography, thirty pages in length, forming one of the appendices, adds to the value of the volume as a book of reference.

The book is embellished by some excellent reproductions of scenic photographs as plates. The diagrammatic folding-maps are adapted from those in the author's paper on African rift valleys in the *Geographical Journal* (July, 1920), and have no geological detail.

With respect to the main theme, Prof. Gregory has presented in his final chapter a lucid and concise retrospect of his opinions. He still holds that a great rift valley, stretching for more than one-sixth of the circumference of the earth, was formed by the subsidence of strips of the earth's crust between parallel tension-faults, consequent upon the breakdown of a precedent broad arch of elevation. He believes that this structure can be traced in the features of the present surface all but continuously from Palestine, by way of the Red Sea and Abyssinia, across East Central Africa, southward to the south-east coast beyond the Zambezi; with branches, eastward into the Gulf of Aden, and westward, by way of the Central Lakes, into the Upper Nile valley. The production of the "Great Rift" is assigned to movements affecting the entire earth between Upper Cretaceous and Pliocene times, and the whole story of these movements is outlined.

It may be so. Anyhow, the idea has its value as a clear-cut working hypothesis. But we really do not know much that is definite yet about the structural features on which the hypothesis rests; and as closer investigation is now in progress at many points along the supposed course of the "Rift," we may expect soon to have better grounds for judgment. Already the existence of the "Rift" along the Red Sea has been called in question by the officers of the Egyptian Geological Survey; and in Uganda the features of the "Western Rift" are pronounced by their latest investigator to be indicative of movements of compression and not of tension (*Geograph. Journ.*, November, 1921). It is generally agreed that the deep troughs of Central and East Central Africa are due to tectonic movement, with which severe faulting is associated; but it remains to be seen whether the troughs can be strung together into a continuous chain of the length and character assumed on the "Great Rift" hypothesis. Meantime let it be acknowledged that in this volume Prof. Gregory once more proves himself to be the capable champion of a bold conception which has already served, and will further serve, for fertile controversy and the increase of earth-knowledge.

G. W. L.

The Quantum Theory.

Die Quantentheorie: Ihr Ursprung und ihre Entwicklung. By Fritz Reiche. Pp. vi+231. (Berlin: Julius Springer, 1921.) 34 marks.

THIS is an admirable account of the whole field of the quantum theory, and should be very useful to anyone who has not followed it from its origin. In a subject like this, which is not yet organised into a consistent whole, it is often exceedingly difficult to judge the importance of any particular branch of the theory. One reads a paper, but cannot form an estimate of its real value, because there is not at hand all the information on cognate subjects. This is especially true of the quantum theory, for the literature is very predominantly German, and it is customary in Germany to permit the publication of much more speculative ideas than is usual in other countries, and the result is that the truth tends to get lost in the mass of paper. The great merit of the present book is that it brings together all the threads of the argument and criticises them, so that a just view can be obtained of the whole theory without struggling through a vast quantity of literature of which a good deal is of little value. It is not a mere compilation of all the views which all writers have held at all times, but a critical estimate of the opinions at present generally accepted.

The book contains 161 pages of text. The mathematics are relegated to a further seventy pages of notes, and the arrangement of these is rather tiresome, for the majority of the notes are simply references to original papers, and there is nothing in the text to distinguish between these and the mathematical calculations.

The order of treatment of subjects is mainly historical, and radiation therefore comes first. This is probably the best arrangement possible at present, though when the theory has been reduced to a classical form it is to be presumed that such a complex question will fall into a much later position. There follows a short discussion on the necessity of breaking away from ordinary mechanics, and then a description of Einstein's hypothesis of light quanta, and the ingenious deductions he makes from the fluctuations in radiant energy. The fourth chapter gives an account of the quantum theory in relation to the physics of solids—such questions as specific heats and Born's work on the dynamics of crystals. The next chapter deals with gases, where the theory is not quite so satisfactory. The rest of the book is mainly occupied with the Bohr theory. It includes all the more recent ideas, such as the correspondence principle, and also a certain amount about atom models.

There is little to criticise in such a fair account of the whole theory, but we may venture to say that the author is perhaps inclined to favour Planck's second hypothesis rather more than would the general consensus of present opinion. That hypothesis seems to give rather better agreement with experiment in the theory of gases, but neither of Planck's hypotheses has yet been made to cover the facts in a really convincing manner. On the other hand, the second hypothesis is quite foreign to the principles of spectrum theory, which agree exceedingly accurately with experiment. Apart from this, anyone wishing to get a just view of the quantum theory cannot do better than read the book.

Our Bookshelf.

Taboo and Genetics: A Study of the Biological, Sociological, and Psychological Foundation of the Family. By Dr. M. M. Knight, Dr. Iva L. Peters, and Dr. Phyllis Blanchard. Pp. xv+255. (London: Kegan Paul and Co., Ltd.; New York: Moffat, Yard, and Co., 1921.) 10*s.* 6*d.* net.

THIS survey of the institutions connected with sexual life and the family falls into three sections. In the biological section Dr. M. M. Knight gives a lucid summary of recent work on sex, drawing the conclusion that the difference between the sexes is quantitative rather than qualitative. In the second section Dr. Iva Peters surveys the ethnological evidence for the taboo of women, and concludes that the modern form of monogamous marriage is essentially a survival of a compromise between man's erotic desires and his fears of woman's *mana*, which has produced an "ideal woman," a type out of harmony with modern developments. This is perhaps the least satisfactory of the three sections. By dwelling too exclusively on taboo and its results it ignores equally important factors in the various social complexes which influence the institution of the family. Dr. Phyllis Blanchard, in dealing with the psychological side of the question, has provided the most stimulating section of the book. By a skilful analysis she places before her readers the chief elements which are responsible for disharmony in modern marriage and the causes which, partly through the increased social activities and individualism of women, are bringing about the exclusion of a large body of the female population from participation in carrying on the race.

Sulphur and Sulphur Derivatives. By Dr. H. A. Auden. (Pitman's Common Commodities and Industries.) Pp. xviii+101. (London: Sir Isaac Pitman and Sons, Ltd., n.d.) 3*s.* net.

DR. AUDEN gives a very readable and accurate account of the manufacture and uses of sulphur and its derivatives, especially sulphuric acid, and his book should prove useful to students and general readers. Although two illustrations of the Gill furnace are given, its mode of operation (which cannot be seen from the illustrations) is not mentioned. The changes observed on heating sulphur are not quite correctly described (p. 5). Moreover, the statement (p. 29) that "almost the whole supply of ammonium sulphate is at present derived from the distillation of coal" refers only to English practice; in more progressive countries very large quantities are produced from atmospheric nitrogen. Although the earlier history of the contact process is given, the real commercial process (p. 61) is not ascribed to any particular inventor—the work of the Badische Co. would seem worthy of mention, and diagrams of the apparatus would also be useful.

Examples in Optics. Compiled by Dr. T. J. I'A. Bromwich. Pp. 16. (Cambridge: Bowes and Bowes, 1921.) 2*s.* net.

DR. BROMWICH has collected sixty questions in optics for use in class-room at St. John's College, Cambridge, and has given references to eighty-four Tripos questions set between 1910 and 1921. The examples printed in the pamphlet cover a fairly wide range, and have evidently been selected by an experienced teacher. In many cases the questions have a direct practical application, or point towards a method of making some important optical measurement. Special attention may be directed to the examples connected with the cardinal points of a system of lenses or refracting surfaces, which should prove a useful supplement to practical work in the laboratory.

Letters to the Editor.

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Transport of Organic Substances in Plants.

THE older writers and modern text-books affirm that the organic materials (carbohydrates, etc.) manufactured in the leaves of plants are transported downwards by means of the bast through their organs to places of consumption and storage. This belief seems to be based entirely on ringing experiments. *A priori* the bast appears to be very unsuitable for carrying out this function. Even in the most rapidly assimilating plants its cross-section is small. It is formed of short cells and comparatively short, narrow tubes, so that many cross-partitions must be traversed by the stream carrying these organic substances if they use it as a conduit. Furthermore, its resistance must be greatly increased by the fact that a large proportion of its cross-section is occupied by viscid contents—protoplasm and proteins. Evidently, in such a conduit we could only expect that velocities of transport comparable with diffusion velocities could be attained. Assuming that a 10 per cent. solution of sucrose were supplied by the leaves and that this was completely converted into an insoluble carbohydrate in a storage organ 50 cm. distant, then we might expect, after a steady state had been attained, a rate of transport, from diffusion alone, of about 2 milligrams per sq. cm. per diem. This would be equivalent to a 10 per cent. solution moving at the rate of 0·2 mm. per diem. Although this diffusion rate of transport might be somewhat accelerated by protoplasmic streaming, it is quite evident that diffusion in the bast is inadequate to account for the observed rate of transport of carbohydrates in plants. The insufficiency of diffusion to transport carbohydrates is strikingly borne out by those experiments in which cut floating leaves exposed to conditions suitable for photosynthesis accumulate carbohydrates, while only negligible quantities find their way into the water.

Close approximation to the velocity of transport in the bast, if that channel alone is used, may be obtained.

For example, a potato weighing 210 grams was attached to a stem by a slender branch about 1·6 mm. in diameter. In this branch the bast had a total cross-section of 0·422 sq. mm. This figure is a maximum, as no allowance was made for cell-walls or any non-functional element in the bast. Through this conduit, *ex hypothesi*, all the organic substance has passed during the growth of the tuber, viz. in about 100 days. According to analyses, more than 24 per cent. of the tuber is combustible; therefore we may assume that approximately 50 grams of dissolved carbohydrate has passed a conduit 0·422 sq. mm. in cross-section in 100 days. The concentration of this solution was probably not more than 10 per cent. Thus 500 c.c. of solution must have passed in 100 days, and the average rate of flow must have been 5/0·00422 cm. per diem, *i.e.* more than 1000 cm. per diem, or about 40 cm. per hour. This is evidently a much greater velocity than could be attained by diffusion in the bast, even when assisted by protoplasmic streaming.

Another way of arriving at the velocity of transport in the bast demanded by this view may be obtained from such recorded results as those of Brown and Morris on the depletion of leaves. When these results are combined with actual measurements of the total cross-section of the bast strands in the petiole we arrive at similar figures for the velocity of transport, *i.e.* if carbohydrate moves as a 10 per cent. solution the velocity of flow must be approximately 50 cm. per hour.

These considerations irresistibly force one to conclude that the cross-section of the bast is not adequate to transmit the amounts of carbohydrates actually known to travel downwards in the stems and petioles of plants. The same arguments seem to apply in ruling out the cortex as the conduit for the general transport of carbohydrates. The greater cross-section available would still be insufficient to allow the quantity transmitted by diffusion alone to account for the quantities observed.

In this connection a fact pointed out to us by Prof. Seward is of peculiar interest. In several species of tree-like Lepidodendra there is no tissue in the stem which presents the structural characteristics of bast, yet we cannot possibly assume that no transport of organic substances back from the photosynthetic organs took place in Lepidodendron.

Many observations indicate that the wood is the tissue in which this transport is effected. Hales, in 1727, published accounts of experiments showing a reversed or downward current in the stem of trees. One of us and Dr. Joly experimented with inarched branches and demonstrated a reverse current, and quite recently Ricca's brilliant work on the transport of the hormone in Mimosa renders the same phenomenon obvious (Boll. della Soc. bot. Ital., Ott., 1915, "Soluzione d'un Problema di Fisiologia," Firenze, 1916). Many observers have proved the presence of carbohydrates in the water of the tracheæ during spring, and one of us, with Dr. W. R. G. Atkins, has shown that these substances are present in a greater or less degree during the entire year (H. H. Dixon and W. R. G. Atkins, Notes from the Botanical School of Trinity College, Dublin, vol. 2, pp. 275 *et seq.*). It is only reasonable to assume that they will travel with the water current whether it moves in an upward or downward direction.[1]

Some very striking evidence for the existence of this reversed current may be obtained with plants of *Solanum tuberosum*. Thus a large potato plant was dug up from the soil with as little injury as possible to its underground stems and roots. After a short exposure to the air, but before any visible wilting had taken place, the apex of one of the leaves was cut off under a solution of eosin by means of a pair of scissors. In an hour the veins of all the leaves, the stems, and the roots were tinged with eosin. Even the roots on the far side of the tuber showed this coloration. When sections of the tuber were examined next day the strands of tracheæ in the bundles showed out with great clearness owing to their injection with eosin. This experiment was made in September.

A similar result was obtained with a specimen of *Chrysanthemum macrophyllum* left undisturbed as it grew. The tip of one of the leaves was cut off and the cut surface immersed in eosin solution at 4 p.m. on an October afternoon. Next morning the eosin was apparent in all the veins of the leaf and could be traced in the bundles of the petiole.

The transmission of clogging and poisonous substances by a reversed transpiration current has been

[1] Lately Curtis has criticised this view, basing his attack on the results of ringing experiments. He does not, however, seem to have taken into account the blocking of the tracheæ which results from morbid changes spreading inwards through the wood parenchyma and medullary rays from the injured region. These effects have been discussed at length by Strasburger, "Leitungsbahnen in den Pflanzen."

demonstrated by one of us (H. H. Dixon, Notes from the Botanical School of Trinity College, Dublin, vol. 2, pp. 5 *et seq.*) in the case of *Tilia microphylla, Syringa vulgaris, Salix viminalis,* and Philadelphus sp. Similarly, Luise Birch-Hirschfeld (*Jahrb. f. wiss. Bot.*, Bd. 59, pp. 171 *et seq.*) has shown that a solution of lithium nitrate may be carried considerable distances downwards in the reversed transpiration stream of various trees, shrubs, and herbs.

Naturally the question obtrudes itself as to how a downward current of dissolved carbohydrates is produced in the wood which is also the normal channel of the upward transpiration current. The subject calls urgently for investigation, and it may not be out of place to mention some of the hypotheses which must be tested.

If it could be shown that the wood of the vascular bundles were divided longitudinally by more or less impermeable partitions into isolated tracheal strands, we might suppose that the tension developed in the water in some of these strands by transpiring cells, while raising the sap in these, might draw down solutions ejected by adjacent cells in neighbouring strands. No such vertical partitions have been described, unless the late summer wood or the vertical plates of parenchyma in the leaf veins and petioles be regarded as such. With such longitudinal partitions a continuous and contemporaneous upward and downward transport might be developed.

An intermittent downward flow might be explained if we could obtain evidence of a periodic or occasional development of permeability in the protoplasmic utricle of the transpiring cells. This might be developed in response to any stimulus, *e.g.* the mounting of tension in the adjacent sap above a certain limit.

The periodic mounting of tension with consequent contraction of the stem, which is indicated in the experiment on the potato plant quoted above, has been established by the elegant observations of Mallock (Proc. Roy. Soc., 1919, vol. 90, B, pp. 186–91) and of MacDougal ("Growth in Trees," Carnegie Institution of Washington, Washington, 1921). These latter show graphically the change of volume of the woody stem of forest trees corresponding to the diurnal period.

Again, the deposit of dew on the transpiring cells, in conjunction with a high tension, might determine a downward flow in the tracheæ, and, with suitable modification of the permeability of these cells, this downward stream might be charged with dissolved carbohydrates.

It is quite evident that the tension assumed here may be developed by temperature changes of the water in the woody tissues and by recovery from flexure just as well as by evaporation. That tension is really responsible is indicated by the experiments quoted above, and also by the fact that no transport occurs from cut leaves floating in water.

If the view that the longitudinal transport of organic substances takes place in the tracheæ is established, speculation naturally arises as to the function of the bast. While the form and arrangement of this tissue seem to preclude any important longitudinal transmission within it, its large peripheral surface and the area of its contact with the cambium and medullary rays seem to suit it for the transmission of organic substances in a radial direction. In this connection the medullary rays may have the function of discharging into, and extracting from, the tracheæ organic substances which are transmitted to and from them by the bast. The observations made by Atkins and one of us that the concentration of carbohydrates in the conducting tracts often diminishes from below upwards suggests that these substances may be extracted from the transpiration current in its upward movement (H. H. Dixon and W. R. G. Atkins, Notes from the Botanical School of Trinity College, Dublin, vol. 2, pp. 335 *et seq.*). The presence of starch in the medullary-ray cells in many plants at all times of the year suggests that the carbohydrates are fixed in these cells as starch. Solution by enzymes of this starch in response to an upward or a downward movement of the water in the tracheæ would provide a mechanism for the upward or downward transport of these substances in the transpiration stream.

It is hoped by experiments which are now in progress to throw some further light on this fundamental problem of plant physiology.

HENRY H. DIXON.
NIGEL G. BALL.

Trinity College, Dublin.

Lunar Periodicity in Reproduction.

IT is a common belief in many fish-markets around the Mediterranean and in other parts of the world that the amount of edible matter in sea-urchins and certain other invertebrates varies with the phases of the moon. The animals are said to be "full" when the moon is full and "empty" at new moon. This belief was recorded by Aristotle, Pliny, and other classical writers, and was stated by them to apply not only to sea-urchins, but also to oysters and other molluscs.

During the summers of 1920 and 1921 I made systematic examinations of the gonads of an Echinoid (*Diadema setasum*) at Suez with the object of testing the truth of the popular statement. I found the latter to be founded on fact to a surprising degree. There is a periodic reproductive cycle in this species of Echinoid which is correlated with the lunar period, the genital products being discharged into the sea at about each full moon during the breeding season. An examination of the testes and ovaries of a number of individuals between the first quarter and full moon shows the majority to be swollen and full of mature spermatozoa or eggs, while a lesser number are "spent," *i.e.* show evidence of having lately extruded their genital products. A week later the relative proportions are reversed. Some individuals have gonads still full of spermatozoa or eggs, but most are now "spent." Between the third quarter and the new moon all gonads are shrunken in size and contain nothing but developing spermatocytes or oocytes. From now onwards until the first quarter of the next moon these cells show progressive stages in development into spermatozoa and eggs which are to be spawned at about the time of full moon. This lunar cycle is repeated throughout the breeding season.

In seeking a causal connection between the reproductive rhythm and the lunar month an influence of the tides first suggests itself. But whereas there is a single reproductive cycle in each lunation, there are two spring and neap tidal periods, *i.e.* a double cycle. However, during the summer months at Suez the new moon spring tides have a greater range than those of the full moon, so that the maximum tidal range is attained only once during each lunar month. The higher and lower water at the new moon spring tides might conceivably react on the Echinoids by the different hydrostatic pressure (affecting, *e.g.*, the tension of dissolved gases) or by causing the animals to be at a greater or less distance than usual from the source of oxygen or of light. But the average excess tidal range at new moon spring tides over that at full moon spring tides during the period studied was only 58 cm. This small difference could scarcely affect the

urchins, for they are not sessile animals, but move actively, their vertical range of migration during the course of an hour being far in excess of this figure.

The possibility of tidal influence could be tested by keeping urchins in a floating cage. If the lunar reproductive cycle were thereby abolished, the tidal connection would be demonstrated; a contrary result from the experiment, however, would not dispose of a possible influence of the tides, for an established rhythm in a physiological process is often persistent after the original cause has been removed. Unfortunately the experiment was impracticable with Diadema owing to its size. Full-grown specimens measure more than one foot from tip to tip of the spines, and it was impossible to obtain large enough floating boxes to contain a hundred or more individuals. I intend, however, to seek further evidence regarding the possible effect of tides by studying Echinoids in localities with greater and smaller tidal ranges than at Suez. I am convinced, though, that if a similar lunar reproductive cycle exists in the sea-urchins at Naples or at Plymouth it is very little pronounced; for I have made use of the Echinoids at these places to obtain spermatozoa and ova for other experimental purposes for months on end without ever noticing a rhythmic variation in the condition or quantity of the genital products. At Suez the period in each lunar month when spermatozoa and eggs are unobtainable would necessarily force itself upon the notice of the investigator.

The possibility of a direct effect of the light of the moon on the Echinoids could be tested by keeping specimens in the dark. Although the large size of Diadema again precluded this experiment at Suez, I intend to carry it out in another place with a smaller Echinoid. If the light has an effect it must necessarily be more constant in the cloudless summer nights of Egypt than in Europe. It was thought possible that the light of the moon might act by causing the urchins to feed either more or less than usual on moonlit nights. A systematic examination of gut contents showed that this was not the case.

Other marine animals popularly believed in Egypt to vary with the moon are mussels and crabs. Contrary to the case of the sea-urchins, I have found these beliefs to be without foundation.

Now it is obvious that the periodic spawning of Diadema must be reflected in the plankton of the Gulf of Suez. The plutei must vary in quantity and in stage of development with the phases of the moon. By an examination of plankton from different parts of the world I hope to discover which of the animals having pelagic larvæ show a lunar reproductive cycle.

The best known example of lunar reproductive periodicity at the present time is the Palolo worm. In the South Pacific these Polychætes swarm at the surface of the sea to discharge their genital products at the third quarter of the October and November moon (Friedländer, *Biol. Centralbl.*, 1898–1901). In Japan another Palolo swarms at both full and new moon, *i.e.* at the spring tides (Izuka, Journ. Coll. Sci. Tokyo, 1903), while in the Atlantic a third species has similar habits (Mayer, Carnegie Inst. Pubs., 1909). Odontosyllis in Bermuda (Galloway and Welch, Tr. Am. Micr. Soc., 1911) and British Columbia (Potts, Proc. Camb. Phil. Soc., 1913), and Nereis (Lillie and Just, Biol. Bull., 1913) and Platynereis (Just, Biol. Bull., 1914) at Woods Hole, Massachusetts, have been shown to swarm at one definite phase of the moon, whereas Nereis at Naples (Hempelmann, *Zoologica*, 1911) swarms at about the first and third quarters. The latter bi-lunar, *i.e.* apparently tidal, periodicity is remarkable, since the tidal range at Naples is much smaller than at Woods Hole. Another Polychæte, Amphitrite, lays its eggs at new and full moon spring tides at Woods Hole (Scott, Biol. Bull., 1909), as does also the Turbellarian Convoluta in Brittany (Gamble and Keeble, Quart. Journ. Micr. Soc., 1903).

To my knowledge the only other case of reproductive periodicity in animals correlated with the lunar period is in the human race. Arrhenius (Skand. Arch. f. Physiol., 1898) showed statistically that there exists a low correlation between the menstrual period and the (tropical) lunar month. In addition, he found traces of a consequent tropical lunar periodicity in birth frequency.

The only authentic cases of lunar rhythm in the reproduction of plants seem to be among the algæ. In North Carolina Dictyota produces one crop of sexual products in each lunar month (Hoyt, *Bot. Gaz.*, 1907). The same plant at Naples (Lewis, *Bot. Gaz.*, 1910), and at Plymouth and Bangor (Williams, *Ann. Bot.*, 1905), has a tidal reproductive rhythm, *i.e.* two cycles per lunation, as is also the case with Sargassum (Tahara, *Bot. Mag.*, Tokyo, 1909).

Popular beliefs in the influence of the moon on plant growth are world-wide, although most of them are probably on a par with the superstition that a waxing moon increases and a waning moon decreases any process, such as the acquisition of wealth, the growth of corns, nails, hair, etc. In Egypt it is said that melons and other fruits of the Cucurbitaceæ grow most rapidly on moonlit nights. The belief that sowing and planting must be done in a waxing, and reaping and cutting in a waning, moon is very widespread. As regards cutting, experiments made recently in Trinidad by Rorer have proved the superstition to be without foundation. It is conceivable, nevertheless, that moonlight may have a photosynthetic effect. Kofoid (Bull. Ill. State Lab. of Nat. Hist., 1903 and 1908) and Allen (Univ. Cal. Pubs. Zool., 1920) have found a maximum frequency of plankton algæ in certain North American rivers occurring at full moon. Kofoid attributes this to lunar photosynthesis, quoting experiments of Knaute (*Biol. Centralbl.*, 1898) in support of his hypothesis. Owing to the great importance of this possibility, and since Knaute obtained a surprisingly large amount of photosynthesis in moonlight, I am at present repeating his work.

I should be grateful if readers of NATURE would communicate to me popular beliefs in lunar influence on animals or plants. It is possible that some of them may prove upon investigation to be as well founded on fact as the case of Diadema.

H. MUNRO FOX.

School of Medicine, Cairo, January 25.

Research Degrees and the University of London.

THERE are at present four degrees in the faculty of science of the University of London which may be granted for a research thesis, namely, D.Sc., Ph.D., M.Sc., and (in exceptional cases only) B.Sc. If a recent report by a sub-committee of the Academic Council should be finally adopted by the University, these four will be reduced to two, D.Sc. and Ph.D., while a new series of examinations will be introduced for M.Sc. As I feel very strongly (with many of my geological colleagues) that this would be a mistaken policy, I venture to ask for space in the columns of NATURE to state my reasons for that feeling.

It would scarcely be necessary to refer to the case of B.Sc. by research but for the serious misconceptions on the subject shown in the sub-committee's report. The granting of this degree is a very rare event, and I have no personal knowledge of any case

of its being granted, but I have always understood that it was reserved for the exceptional case of a serious scientific investigator whose academic career has been interrupted after the intermediate stage and who wishes to resume it at an age when the concentrated study necessary for the passing of the final B.Sc. examination cannot reasonably be required of him. If there is any reason to fear possible abuse of this means of graduating, it would be a simple matter to fix a minimum age-limit for it—say thirty-five—rather than to abolish it.

The immediate importance of the B.Sc. by research, however, is that it gives the sub-committee an opportunity to exaggerate the number of standards of research which examiners have to keep in their minds. The report says: "We do not consider it satisfactory that there should be as many as three, and still less four, degree standards of research." There is no fourth standard. I cannot conceive any examiner recommending the B.Sc. degree for a thesis which would be rejected for M.Sc. if offered by a graduate. On the contrary, I can easily imagine the University making it a rule to accept no thesis for B.Sc. which it would not accept for Ph.D., or even D.Sc., if this means of graduation is reserved for very exceptional cases. The conditions under which alone B.Sc. by research should be granted forbid the standard from making a fourth with the three standards of post-graduate research degrees. As to those three standards, as an examiner I have not found any difficulty in framing three standards in my own mind or in agreeing upon them with my colleagues. On the contrary, I find that the introduction of the Ph.D. degree has made it easier to define the standards of the two others. If the M.Sc. by research be abolished, the Ph.D. standard will inevitably tend to sink, until in a few years it will be equivalent to the present M.Sc.

I am certainly not speaking for myself alone when I express myself as strongly in favour of the retention of the M.Sc. by research; but if the University should decide to abolish it, I should very much prefer the abolition to be complete rather than that the degree should be granted by examination. The work of a candidate for M.Sc. by research must necessarily consist very largely (in some cases entirely) in a survey of the knowledge already acquired on the subject which he proposes to investigate. This involves the intensive study of original works of research possibly going far back into the early history of science and extending into various branches, all connected together by their bearing on some one problem. In geology, for instance, such an investigation may often include portions of the several branches—petrology, stratigraphy, palæontology, and economic geology.

A candidate studying for M.Sc. by examination will be engaged on very similar work, but its boundaries will be arbitrarily determined for him by the definition of some particular subject which he chooses from a published list. He will be warned off side-issues that may attract him by the fact that they will not form part of the subject-matter of his examination. He will be much more inclined to rely on text-books than on original papers, and any tendency to run down obscure questions for himself in the literature of the subject or by personal observation and research will be positively disadvantageous to him, since he will be discovering facts probably unknown to his examiners.

Examples could easily be found of able investigators whose life-work originated as a side-issue from an early line of study. At the beginning of post-graduate life a man cannot be expected to choose irrevocably his main line of work.

As an examiner I am convinced that the Honours B.Sc. stage is the highest at which examinations are of value, except as an altogether subordinate part of the qualifying test. After this stage every incentive should be given to the student to work on lines determined by his particular interests and opportunities, and not by what must be, even when every effort is made to avoid it, an arbitrary pigeon-hole sub-division of the sciences.

A. MORLEY DAVIES.

Imperial College, S.W.7, February 9.

The Accuracy of Tide-predicting Machines.

I SHOULD like to make a few comments on Mr. Marmer's letter in NATURE of February 2, p. 136, as I was responsible for the tests made on the British machines referred to in your review of "British Research Work on Tides."

In his last paragraph Mr. Marmer states the various uses that can be made of tide-predicting machines in addition to their normal use. Most of these are quite likely to be well within the capacity of any machine, since relatively small quantities only are involved and the full scale of the machine can be used. But their use in "the elimination from the observed tide of the tide due to a number of constituents" is precisely that which was shown to be undesirable so far as the British machines were concerned. It has been found very advantageous in research work to subtract known constituents from the tidal record and to examine the residue, but for such work it is of prime importance to know that what we have actually removed is exactly what it professes to be. It is not desirable to spend time and energy on the examination of fictitious residues due to machine errors, and it was found that the British machines were subject to systematic errors of about 0·5 ft. in hourly heights (though not in heights of high and low water), with a spring range of 18 ft. Such errors entirely prohibited the use of these machines.

It is quite probable that the performance of the British machines can be improved, but the labour of reading the curves will be great. In this respect the U.S.A. machine has a notable advantage, and I should be very glad to know that one could obtain from it hourly heights with an accuracy suitable for research work, say to within 0·05 ft. for a spring range of 30 ft. But in fairness to the British machines, and not with a desire to impeach the working of the U.S.A. machine, I must say that I am not convinced by the tests recorded by Mr. Marmer. At Hong Kong the spring range of tide is only 4·5 ft., and if the full powers of the machine have been used, as is reasonable to suppose, then we should expect a *pro rata* error of 0·4 ft. with a spring range of 30 ft. It is fervently to be hoped that such is not the case, though I must confess that certain comparisons I have made between direct calculations and U.S.A. predictions show discrepancies of this magnitude, even in high- and low-water heights. Further, the difference in predictions between the U.S.A. machine and one of the British machines is much greater than is to be expected, if it be due to the errors only of the latter.

It is very noteworthy that the performance of the U.S.A. machine in 1922 agrees very well with its performance in 1910, indicating that its errors are truly systematic; but this is no consolation to a research worker unless he knows what the errors are. It is easy to see that the errors have not any obvious relationship to the actual tide predicted. The tests illustrate the difficulty one would have in dealing with the residues, for of the thirty constituents used about half are individually less than the error of the machine.

If only the largest constituents had been used the task of analysing for the remainder would have been made more onerous by the presence of this error, and much more so if there were unknown constituents to deal with.

I quite agree with Mr. Marmer that the only satisfactory method of testing the machines is to compare their results with the results of numerical or "hand" calculations, but such tests should be exhaustive and convincing. A. T. DOODSON.

Tidal Institute, University of Liverpool,
February 9.

The Brittleness of Ice at Low Temperatures.

SIR GEORGE BEILBY ("Aggregation and Flow of Solids," 1921) has recently directed attention to the impossibility of explaining the flow of glaciers at temperatures much below 0° C. on the regelation hypothesis, and the necessity for assuming a deformation of the ice-crystals by displacement along internal-glide planes or at the crystal boundaries. From his experiments on the behaviour of metals and minerals under pressure he suggests that in ice a vitreous modification will be produced at the plane of displacement, and that above a certain temperature—the "crystallisation temperature"—this will immediately revert to the crystalline state, the process being repeated indefinitely during movement. Should the temperature of the ice fall below this point it is predicted that the flow will be retarded, as the vitreous modifications of metals are harder than the crystalline, and their presence promotes rigidity.

It seems that here we have an explanation of the brittleness of ice at low temperatures. Navigators in the pack have noticed that the development of the pressure ridges is noiseless in summer, but accompanied by loud detonations in winter. Another consequence of the existence of this state at low temperatures is well known to every ski-runner in a distinct loss of gliding power. Sir George Beilby has shown that the "crystallisation temperature" for ice must lie somewhere below −12° C. There is general agreement in Norway that the "føre," though deteriorating slowly as the temperature falls below −5° C., receives a marked check at about −17° C., and Nansen's observations in the pack are fairly consistent with this figure. To test the validity of the explanation offered we must await the experimental determination of the "crystallisation temperature" of ice. L. HAWKES.

Bedford College, Regent's Park, N.W.,
February 4.

Age Incidence of Influenza.

WAS not the unusual age incidence of deaths in the influenza epidemic of 1918–19, referred to in NATURE of February 2, p. 130, due to the special circumstances of that time? With few exceptions, all civilians in this country at that date between the ages of twenty and thirty-five could have been placed in one of three classes:—

(1) Persons engaged in war-work on the land, in factories, offices, etc. All these were doing a full man's working day (judged by the standard of normal times), and many were seriously overworking.

(2) Ex-Service men discharged on account of ill-health.

(3) Mothers of young children, who in many cases went short of food themselves in order to ensure an increased ration for their families.

None of these would have been so resistant to infection, or so well able to throw off disease when contracted, as they would have been in normal times. ANNIE D. BETTS.

MISS BETTS suggests that the exceptional incidence of influenza mortality during the pandemic of 1918–19 may have been caused by the exceptional war-conditions, leading to the greatly increased occupation of women, to overwork of these and of men, and to the state of health of ex-Service men. To these suggested causes may be added the effect of the rationing of food, which might affect to an exceptional extent the mothers of young children.

These explanations of the strangely inverted age incidence of influenza mortality have been often debated. They cannot explain the course of events more than to a minor extent. For (1) with such an infectious disease as influenza domestic infection of older persons, even when they had escaped extra-domestic infection, must have been the general rule. War-conditions must surely have told heavily on aged persons.

(2) Curves given on p. 41 of the Registrar-General's Report on Influenza (Cmd. 700) show that this change in age incidence was unparalleled in the history of the disease, and that the changed age incidence characterised the beginning of each of the three consecutive waves of the disease. With the progress of each there was a diminishing youthfulness of decedents.

(3) This change in age incidence was not confined to this country or to other belligerent countries especially affected by war-conditions. It occurred, for instance, in Scandinavian countries and in America.

(4) The explanation that those attacked in the 1889–91 epidemic—the older section of the population—were relatively immune is not supported by any adequate body of evidence.

In short, the altered age incidence of influenza in the recent epidemic remains an unsolved problem. An easy way out of the difficulty, though a way probably not according with facts, would be to assert that the recent pandemic was a different disease from that of 1889–92. THE WRITER OF THE ARTICLE.

Dr. Frank Bottomley.

MAY I be permitted to make a correction of an error in Sir Richard Paget's obituary notice of my cousin, Dr. Frank Bottomley, in NATURE of February 16, p. 212? Sir Richard states that Frank Bottomley's stepmother was "the widowed sister of Lord Kelvin." Frank Bottomley's father, being a son of Lord Kelvin's sister Anna, could not possibly have married another of the sisters. Lord Kelvin had three sisters, namely, Elizabeth, widow of the Rev. David King (she never remarried); Anna, Mrs. William Bottomley, who was Frank Bottomley's grandmother; and Margaret, who died in early childhood. As a matter of fact, Frank Bottomley's stepmother was a sister of Lord Kelvin's second wife.

JAMES THOMSON.

22 Wentworth Place, Newcastle-upon-Tyne,
February 19.

Thermo-electric Instrument for Measuring Radiation from the Sky.

IN the note on Mr. W. H. Dines's memoir on "Observations of Radiation from the Sky" (NATURE, January 12, p. 54) you attribute to me the final design of the instrument. Permit me to say that Mr. Dines greatly elaborated and improved the thermo-electric instrument after I left it.

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The Mechanism of Heredity.

By PROF. T. H. MORGAN, Columbia University, New York City, U.S.A.

I.

Mendel's Two Laws of Heredity and their Mechanism.

AT the time when Mendel discovered his two fundamental laws of heredity, no mechanism was known in plants or animals that would explain how such processes as those invoked by him could be brought about; but between 1865 and 1900 (when Mendel's "Principles" were recovered), the study of the ripening process (maturation) of the egg and sperm-cell had progressed so far that such a mechanism was ready at hand.

Mendel's first law—the law of segregation—may be illustrated by the following example: A tall edible pea crossed to a short pea gives tall (hybrid) offspring. These, if self-fertilised, produce on an average three talls to one short. Mendel pointed out that a very simple hypothesis will account for this ratio of 3 : 1 in the second generation (F_2). The original tall parent contributes one element (T), and the short parent another element (*t*) to the hybrid. If at the time when its germ-cells mature these elements separate (segregate), so that half the eggs come to contain the element for tallness (T), and the other half the element for shortness (*t*), and if a similar process takes place in the pollen of the hybrid (half the pollen grains bearing T and half *t*), then chance fertilisation of any egg by any pollen grain will be expected to give three kinds of individuals, namely TT, T*t*, *tt*, in the ratio of 1 : 2 : 1. The first two kinds (TT and T*t*) will be tall plants, because the one (TT) is pure for tallness, and because in the other (T*t*) tallness dominates shortness as seen in the hybrid. Hence the second generation will be made up of three talls to one short.

The unique feature of the situation, the segregation in the germ-cells of the hybrid of the elements derived from each parent, finds a parallel in the distribution of the maternal and paternal chromosomes of the hybrid. For example: every cell of the hybrid contains one chromosome (*a*) from one parent, and one chromosome (A, the mate of the former) from the other parent. But this condition is not permanent in its germ-cells, for when they arrive at the final ripening stage, the two chromosomes (*a*A) come together, conjugate, and then "segregate," *i.e.* they pass into opposite cells. As a result, half the eggs contain chromosome *a*, half chromosome A. They behave like Mendel's pair of "characters." Hence if the materials responsible for the difference between T and *t* are carried by the members of the same pair of chromosomes, A and *a*, they must follow Mendel's first law.

Mendel's second law applies to the independent behaviour of two or more pairs of characters: the members of each pair assorting independently of the members of other pairs. It has been generally supposed by cytologists that at the ripening of the germ-cells the members of the pairs of chromosomes separate independently, in the same way that Mendel supposed the individual pairs of characters to be distributed. Proof was difficult to obtain from direct observation, but recently this evidence has been abundantly and convincingly obtained by Miss Carothers. If then the chromosomes carry the materials (genes or differentials) for the hereditary characters, they behave in such a way as to ensure the success of Mendel's second law.

Had we only this parallelism to go upon we should be justified, I think, in accepting the chromosome theory of heredity as a working hypothesis, but further evidence has been steadily accumulating. It may be briefly summarised, yet must be given in some detail; for it is the exact correspondence between fact and theory that furnishes the essential data for the conclusions arrived at.

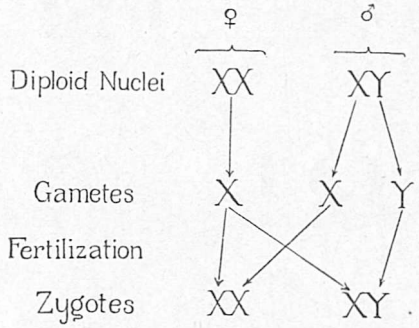


FIG. 1.

(1) In some groups of animals it has been shown that one pair of chromosomes (XY) acts as a differential with respect to sex determination (Fig. 1). The female has two like chromosomes, called X and X; the male has one X, and often another chromosome called Y. Thus XX = ♀; XY = ♂. These chromosomes segregate at maturation, as do the others. Every egg eliminates one X in one of its polar bodies; half the sperms are X-bearing, half Y-bearing. Any egg (X) fertilised by an X-sperm = XX (♀); any egg (X) fertilised by a Y-sperm = XY (♂). Thus sex is here determined by a process that automatically gives equal numbers of males and females.

A son always gets his single X from his mother; a daughter gets one X from her mother, another from her father. Certain characters follow in their heredity the course taken by these chromosomes. For instance, if the mother is *aa*, and the father is A, each son will be *a*, each daughter will be *a*A.

Many examples of this sort could be given, and further tests of the different kinds of individuals that appear in such crosses could also be cited to show that the distribution of the sex-linked characters follows the distribution of the X-chromosomes. This evidence is so significant that it may be further illustrated by a concrete case. If a white-eyed female of the vinegar fly, *Drosophila melanogaster,* is bred to a red-eyed male (Fig. 2), the sons are white-eyed, and the daughters are red-eyed (red dominates white). If these are inbred there appear in the next generation white-eyed daughters, red-eyed daughters, white-eyed sons, and red-eyed sons in the ratio of 1 : 1 : 1 : 1.

The distribution of the X- and Y-chromosomes is illustrated by the rods in the middle of the diagram. The white rod stands for the X that carries the differential for recessive white eyes. The black rod stands for the X that carries the

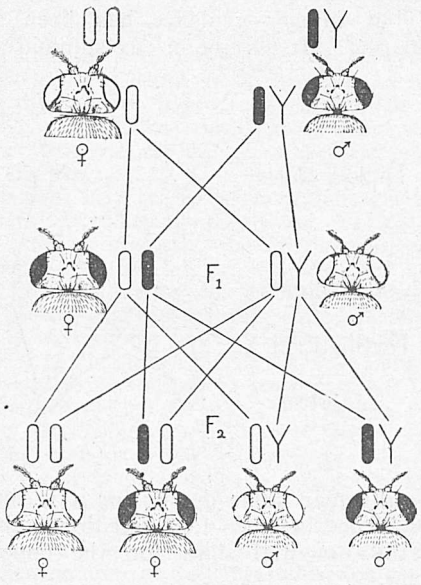


FIG. 2.

differential for dominant red eyes. The Y-chromosome is represented by that letter. It is obvious from the way in which these chromosomes are distributed that there should be both red-eyed and white-eyed grandchildren in equal numbers.

The reciprocal cross gives a different result (Fig. 3). Thus, when a white-eyed male is bred to a red-eyed female, both the sons and the daughters have red eyes. If these are inbred, there appear in the next generation red-eyed daughters, red-eyed sons, and white-eyed sons in the ratio of 2 : 1 : 1. Here also it is evident from the distribution of the X's why, in the second generation, the only white-eyed flies present are males. These carry a single white-producing X that traces back to the grandfather. All the granddaughters have red eyes, but are of two kinds, one pure for red, and the other carries both a red and a white rod. If these second-generation females are tested it is found, in fact, that half of them carry two red-producing chromosomes, and the other half a red and a white one. Evidence like this from sex-linked inheritance, where both the genetic and the chromosomal histories are known, furnishes by itself very strong evidence in favour of the chromosomal interpretation of heredity, but there is further evidence that makes the case even stronger. This evidence may now be briefly stated.

(2) Individual females of the fly Drosophila are

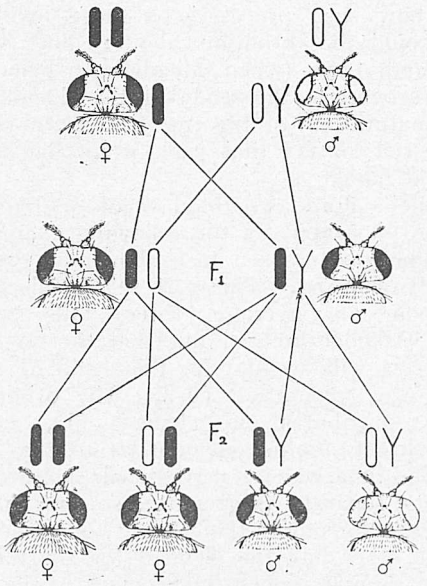


FIG. 3.

sometimes met with that break the rule for sex-linked inheritance. A genetic study by Bridges of this exceptional behaviour led to the prediction that they must have an extra sex-chromosome. Cytological examination showed, in fact, that there is in these females an X- and another X- and a Y-chromosome (Fig. 4). The genetic behaviour of the "non-disjunctional" females is so important for the chromosome theory that it must be followed through carefully. It will be simpler to give the genetic and the chromosome histories together.

XXY ♀

FIG. 4.

When an egg containing the three chromosomes XXY matures, the two X's may conjugate, leaving the Y free to go to either pole of the polar spindle (this happens in 92 per cent. of the cases), or else an X and the Y may conjugate, leaving the other X to go to either pole. As shown in the diagram (Fig. 5), four kinds of eggs result (and four kinds of polar bodies are extruded). If the non-disjunctional female in question has white eyes, the history of her white-bearing X's can be followed when she is fertilised by a male with a red-bearing X-chromosome. Considering first the fertilisation of her four kinds of eggs by the red-producing X-sperm of the male, it is evident that there will be produced four kinds of individuals, viz. XXY, XX, XXX, and XY.

Two of these red-eyed females are both hybrid for white; one of them should be a non-disjunctional female (XXY) and repeat the same process. Such

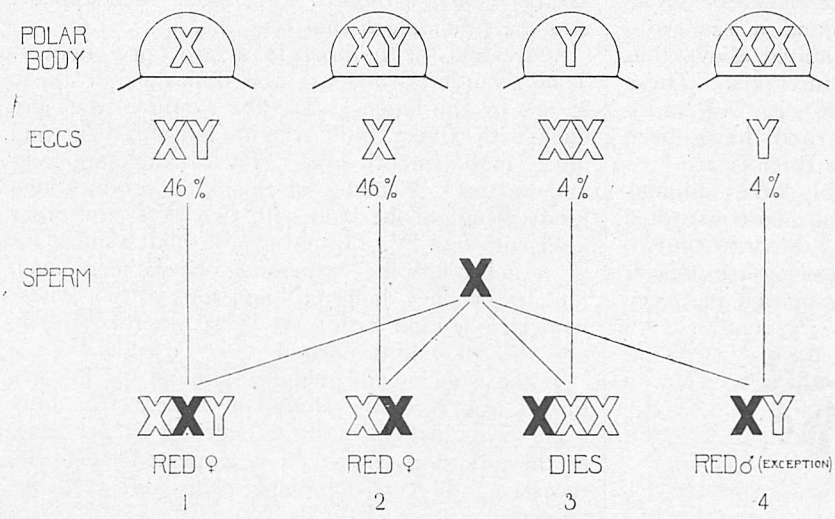


FIG. 5.

is the case. The females with three X's generally die, but occasionally one emerges that can be identified as such by certain peculiarities, and when the cells of such a female are studied it is found that three X's are present (Fig. 6). Lastly, there is a male, XY, with red eyes, an "exceptional male," since his mother had white eyes. He arises from a Y-egg fertilised by an X-bearing sperm—the so-called female-producing sperm. Here such a sperm makes a male because the combination of one X with the rest of the chromosomes is a male in these flies, quite irrespective of the origin of the X-chromosome. The result shows convincingly that the X-sperm normally gives rise to a female because it carries an X (the egg supplying another X), and not because its X is carried by a "female-producing" sperm.

XXX ♀

FIG. 6.

There remains to be considered the case where the same series of eggs is fertilised by the other kind of sperm, the Y-bearing sperm. In the lower line of Fig. 7 the outcome is shown. Two kinds of males appear, both white-eyed, but one XYY and the other XY. The latter, XY, is found to be a normal male; the former is expected, in some cases, to transmit both an X and a Y through his "female-producing" sperm and give rise in this way to non-disjunctional daughters (XXY). This, in fact, has been shown to occur.

The single class of females that appears in this series arises from the fertilisation of the XX-egg by a "male-producing" (Y) sperm. She has white eyes and "breaks the rule." She must, furthermore, from her origin, be herself a non-disjunctional female, and, in fact, has been shown to behave as such. Finally, the YY individual in the diagram is not found, and probably dies, as is to be expected, since it contains no X-chromosomes.

(3) From an entirely different source new proof of the chromosome theory has been found. This, too, involves the sex-chromosomes. We have a stock that gives results diametrically opposite to ordinary sex-linked inheritance. The females

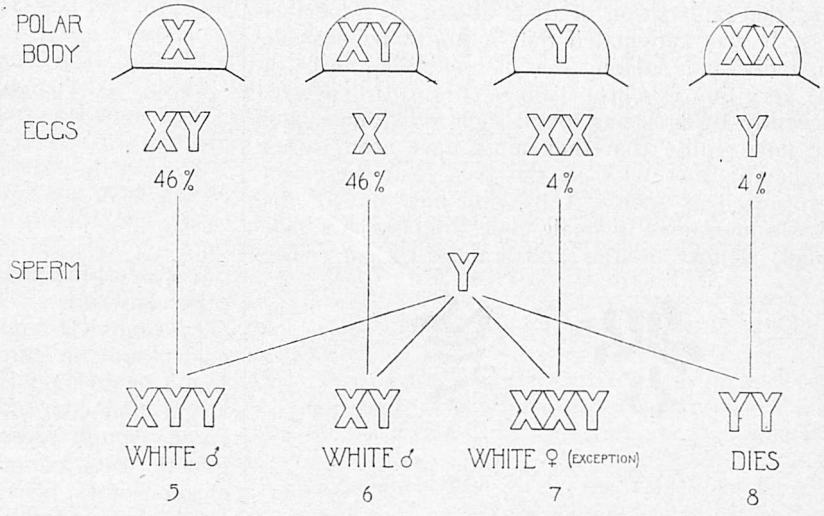


FIG. 7.

are yellow (recessive), and give, when bred to a normal grey male, yellow daughters and grey sons. A study of this stock by L. V. Morgan, who discovered it, showed that all the results could be explained by the assumption that two X-chromosomes, bearing yellow, had become stuck together. Sections of these females verified the prediction. Two united X-chromosomes and a Y are present in the yellow females (Fig. 8). At maturation of the eggs both X's pass out together into the polar body at the reduction division, or else both remain in the egg. Thus the mature eggs are XX or Y. Fertilised by a normal "grey" X-sperm, the XX egg gives an XXX grey female (which dies as a rule) and an XY

grey male. Fertilised by a Y-sperm, the two kinds of eggs give XXY yellow females and YY individuals (which die). Thus, of the four kinds of individuals expected, half the females (XXX) and half the males (YY) die, and a sex ratio of 1 : 1 remains. It has been stated above that XXX females appear at rare intervals. These are grey and are recognisable as XXX individuals by certain stigmata, and have been shown in sections to possess the three X's.

(4) Drosophila, and presumably other animals belonging to the XX–XY type, are so constituted that they can develop with one X or with two X's, provided the other chromosomes are present in duplex. In short, sex determination has been

FIG. 8.

regulated along these lines. Failure to obtain similar situations in the case of the other chromosomes led us to suppose that an individual lacking one or both members of a pair could not "come through"; but we had no actual proof that this was the explanation of their absence. Nevertheless, it was anticipated that it might be possible for individuals lacking one or containing three of the very tiny IV-chromosomes (Fig. 9) to survive. Recently Bridges has found such individuals, and we now realise that they must have been rather frequently met with in the past, but were not recognised as such. A fly with only one of the IV-chromosomes is small, pale, hatches late, has small, slender bristles and a dark trident. The

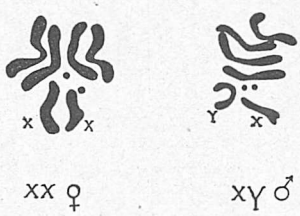


FIG. 9.

wings are blunt and slightly spread, and the eyes large and roundish. If a female, it is expected to contain two kinds of mature eggs (*i.e.* eggs after the polar body has been extruded)—one kind with, the other kind without, a IV-chromosome. The egg with one IV-chromosome gives a normal result when fertilised. The egg without a IV-chromosome, if fertilised by a sperm carrying a recessive IV-chromosome character, produces an individual (♂ or ♀) showing the recessive character of the father, because the single IV-chromosome of this individual came from the father that carried the recessive in question. A male that has only one IV-chromosome in its cells produces two kinds of sperm, one with IV and one without IV. Mated to a normal female, the results are in principle the same as above. A male and a female, each with only one IV-chromosome, when mated, might be expected to give some individuals (25 per cent.) without a IV. None such appear, and the ratios show that they die.

Individuals with three IV's are also known. Their characteristics are the opposites of those shown by the haplo-IV's. For example, they are dark with a very faint trident, long-bristled, and have small, smooth eyes. Their wings are long and narrow. Females of this kind produce two kinds of eggs, one kind with two IV's, the other kind with one IV. Mated to a normal male, with a IV-chromosome recessive character, such females produce daughters and sons of two kinds, namely, one kind with three IV's, like the mother, and the other kind normal.

If these males and females, triploid for IV, are mated, the recessive character appears in only 4 per cent. instead of the Mendelian 25 per cent. of the offspring, as would be expected when one recessive and two dominant characters are involved.

Many combinations between triploids and haploids are possible, and unique ratios are expected. These have also been worked out. Cytological preparations of triplo- and haplo-IV's show in

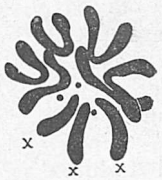


FIG. 10.

one case three small chromosomes, and in the other only one.

(5) Complete triploid individuals having three of each kind of chromosome have recently been found by Bridges (Fig. 10). The triploid flies are larger and coarser than normals, and also have large, rough eyes. Their eggs, as shown by genetic tests, contain all possible combinations of chromosomes, behaving as though non-disjunction takes place independently in each set of three.

Amongst the offspring of a triploid female (mated to a normal male) there is one class that has three II's, three III's, and three IV's, but with two X-chromosomes. This individual is an intersex, more like a male than a female. There is another class that has three II's, three III's, but only two IV's. It also is an intersex, but more like a female.

Thus sex itself, in this animal, is shown to be an expression of a balance between the X-chromosomes and the rest of the chromosomes. The results show that the differentials which determine sex are not confined to the sex-chromosomes alone. Some appear to be in the II- and III-chromosomes, and others in the IV-chromosome.

(*To be continued.*)

Obituary.

PROF. GIACOMO CIAMICIAN.

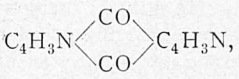
BY the death of Prof. Giacomo Luigi Ciamician, of the University of Bologna, Senator of the Kingdom of Italy, which occurred on January 2 of the present year, Italy has lost one of her most distinguished men of science, and modern chemistry one of the most assiduous and most successful of its cultivators.

Ciamician's work was characterised by the breadth and originality of its grasp. It ranged practically over every department of the science—spectrum analysis, electrolytic dissociation, organic synthesis by plants, chemical action of light, spatial chemistry—but it was mainly concerned with problems of organic chemistry, and it is by his labours in certain special fields of this branch that he will be chiefly remembered. One of his earliest investigations was an inquiry into the chemical nature and constitution of the resins and gum-resins—a confessedly difficult and complicated subject forty-five years ago when he first attacked it. By distilling abietic acid, the main constituent of colophony or ordinary rosin, with zinc-dust in a current of hydrogen—a reduction-process which had been already proved to be of general utility—he obtained a number of aromatic derivatives, notably toluene, *m*-ethylmethylbenzene, naphthalene, methylnaphthalene, and methylanthracene. Gum-benzoin similarly treated yielded similar products, together with small quantities of xylene. Elemi-resin also yielded toluene, and ethylmethylbenzene and ethylnaphthalene, but no naphthalene or methylanthracene. Gum-ammoniacum gave both para- and meta-xylenes and meta-ethylmethylbenzene, and the methylether of ortho-ethylphenol, but no naphthalene derivatives. These observations are of considerable interest, but they do not necessarily throw light upon the constitution of the terpene-resins, as certain of the products may be the result of secondary reactions. In fact, aldehyde-resin, obtained from ordinary aldehyde and therefore not an aromatic derivative, on reduction with zinc-dust, was found to yield ethylbenzene, meta- and para-ethyl toluene, and methylnaphthalene.

In 1881 Ciamician attacked the chemistry of pyrrole, a constituent of the fetid-smelling product obtained by heating bones in the preparation of animal charcoal, and hence termed bone-oil or Dippel's oil, from the name of the chemist who, so far back as 1711, first attempted to get an insight into its nature. This product has been known for at least four centuries, and has been the subject of repeated inquiry.

The investigation of pyrrole, first isolated by Runge in 1834, its congeners and derivatives, occupied Ciamician, at intervals, for upwards of a quarter of a century, and he published, partly alone, and partly in conjunction with Dennstedt, Weidel, Anderlini, Magnaghi, Magnanini, Silber, and Zanetti, no fewer than sixty communications on its chemistry. In 1904 he reviewed all this work in a lecture delivered to the German Chemical Society, afterwards printed in vol. 37 of its Berichte. It forms a remarkable chapter in the development of a section of organic chemistry with which Ciamician's name will always be associated He established the nature of pyrrole as a secondary amine, its carbon and hydrogen atoms forming a closed chain, the hydrogen atoms being symmetrically situated with respect to the carbon atoms, as suggested by Baeyer. Its formation from succinimide by distillation with zinc-dust, and the fact that it yields succinaldehyde dioxime by the action of hydroxylamine, conclusively established this view of its constitution.

Ciamician's work on pyrrole had many side issues. He elucidated its relations, not only to the substances with which it is associated in bone-oil, such as pyridine, into which he showed it might be converted, but also to indole and indigo. He was naturally led to the study of the products of the destructive distillation of gelatin, and, with Weidel, discovered pyrocoll, which he regarded as a quinone of the constitution



or as the anhydride of carbopyrrolic acid, of which, with Silber, he prepared a number of derivatives, and eventually effected its synthesis by heating a solution of carbopyrrolic acid in acetic anhydride, when pyrocoll, with all the properties of that obtained from gelatin, sublimes.

Pyrrole derivatives are concerned in vital processes. They have been found in plants, and certain of them have been shown by Willstätter to exist among the decomposition products of chlorophyll and of hæmoglobin—one more illustration of the remarkable analogies which exist between these substances so important in their physiological functions.

Ciamician was early attracted to plant chemistry, and made important contributions to our knowledge of the nature and constitution of substances produced by photosynthetic processes in the vegetable organism. He determined the constitution of apiole, a substance found by von Gerichten in parsley seeds, and of the analogous compounds safrole, the chief constituent of the essential oil of sassafras and found in other natural oils, leaves, and fruits, and eugenol, a still more widely distributed natural product. With Silber he investigated the constituents of coto- and paracoto-bark, substances of pharmacological interest, and derived from plants growing in Bolivia and Venezuela.

A growing plant is a living laboratory in which synthetic processes may be directed, controlled, or modified, as in the human organism, by external means. In conjunction with Ravenna, Ciamician studied the effect of the introduction of various natural organic products into plants, with the view of determining their fate, or their influence on the life-history or development of the plant. They showed that plants will tolerate and utilise glucosides, such

as amygdalin, salicin, and arbutin, but will quickly die when the aromatic constituents of these glucosides are separately introduced. They found that plants are capable of transforming saligenin, benzyl alcohol, and vanillin into glucosides, saligenin, for example, being converted into salicin. They studied the effect of the inoculation of pyridine, piperidine, and pyrrole derivatives on the formation of alkaloids; they found that the amount of nicotine in the tobacco plant could be considerably increased by the introduction of dextrose. Their results lent support to the view that vegetable alkaloids have their origin in amino-acids, and that bases, such as lysine and ornithine, formed from amino-acids, are utilised by plants in the synthesis of alkaloids.

The chemical action of light has long been a special study with Italian chemists. Blessed with sunnier skies than we enjoy in these latitudes, they have had ampler opportunities than we possess to observe its effects, and, thanks to their long-continued and systematic work, a considerable body of information has been accumulated. Some of Ciamician's earliest observations had reference to this subject, and it continued to interest him to the end of his days. He noticed the conversion under its influence of quinone into quinol; of an alcoholic solution of nitrobenzene into aldehyde, aniline, and quinaldine; and of *a*-nitrobenzaldehyde into *o*-nitrosobenzoic acid, the nature of the changes and the character of the products formed being affected by the vehicle in which the substances under examination were contained, and the refrangibility of the light-rays. Unsaturated compounds tended to polymerise. An aqueous solution of acetone yielded acetic acid and methane; maleic acid was converted into fumaric acid; vanillin, piperonal, salicylaldehyde, and cinnamaldehyde yield the corresponding acids; lævulic acid forms propionic acid; many cyclo-ketones are broken down and fatty acids and aldehydes formed; benzaldehyde is resinified, and may be condensed with many different compounds; solutions of benzophenone in aromatic hydrocarbons yield benzopinacone, and the hydrocarbon undergoes condensation; camphor in dilute aqueous alcoholic solution yields acetaldehyde and campholenaldehyde; fenchone forms carbon monoxide and fenchone hydrate. Aromatic hydrocarbons in presence of water and oxygen are partly oxidised to the corresponding carboxylic acids. Pyrrole by prolonged exposure is completely decomposed, one of the products being succinimide, which may be regarded as the ketonic form of the quinol of pyrrole.

This is but a bald and imperfect summary of an intensely interesting and most important chain of observations, the full significance of which is scarcely yet realised. The potency of light has, of course, long been recognised, but no such evidence of its power to induce chemical action had hitherto been adduced as that afforded by Ciamician's work.

Ciamician was an accomplished, well-informed man, of great personal charm, whose influence on the chemistry of his epoch will long be felt. His merits were widely recognised. He was a foreign associate of the French Academy and an honorary fellow, since 1911, of our Chemical Society. He was an occasional visitor to London, and personally known to some British chemists who will long cherish his memory as an earnest and single-minded follower of the science he has done so much to enlarge and adorn. T. E. THORPE.

WE regret to see the announcement of the death on Saturday, February 18, of SIR JOHN MCCLURE, who for the past thirty years has been headmaster of Mill Hill School. Sir John McClure, who was born in 1860, received his education at Cambridge, where he took mathematics and law. From 1885–91 he acted as lecturer in astronomy and other scientific subjects under the Cambridge University Extension Syndicate, while from 1888–94 he was professor of astronomy at Queen's College, London. It was in 1891 that he received the appointment of headmaster at Mill Hill School, a post which he filled with conspicuous success for more than thirty years. The school, which was founded in 1807 for the education of Nonconformists when the older universities were not open to them, was reconstituted in 1869, and flourished for a time; but when Sir John McClure arrived in 1891 there were only sixty-one boys. He immediately set to work to develop and reconstruct the school, with the result that last year he was able to announce that the number of boys under his charge had grown to 361. Sir John McClure was also active in the cause of education outside his school. From 1904–13 he was honorary secretary of the Incorporated Association of Headmasters, and later became president, and it was mainly in recognition of these and similar services to education that he received the honour of knighthood in 1913.

ORIENTAL learning has suffered a grievous loss by the death, at the age of eighty years, of SIR ARTHUR NAYLOR WOLLASTON, K.C.I.E. Appointed to a post in the India Office at the age of sixteen, Wollaston served for forty-eight years in that Department. In 1898 he succeeded the late Mr. F. C. Danvers as registrar, and he was so successful in arranging the voluminous series of records that they became readily accessible to students. In this task he was succeeded by his pupil, Mr. W. Foster, who has done valuable work in calendaring the collection. Wollaston, in addition to his official duties, became an admirable Persian scholar, though he never had the good fortune to visit the East. He translated the Fables of Bidpai, and edited Sir Lewis Pelly's "Miracle Play of Hasan and Husain." But the work by which he will be best remembered is his great English–Persian Dictionary. At Walmer, where he resided for many years, he took an active share in the local administration.

THE death is announced of PROF. ERICH EBLER, professor of inorganic and analytical chemistry in the newly founded University of Frankfort-on-Main. Prof. Ebler, who was forty-two years of age, was appointed only in 1920, after service with the Army in the field.

Current Topics and Events.

WE are glad to be able to announce that representatives of British science are included among those who have received their Majesties' invitation to the marriage of Her Royal Highness Princess Mary on Tuesday next, February 28.

PROF. F. G. HOPKINS and Dr. W. H. R. Rivers have been elected members of the Athenæum Club under the rule which empowers the annual election by the committee of a certain number of persons "of distinguished eminence in science, literature, the arts, or for public service."

IN a letter to NATURE of May 19, 1921 (vol. 107, p. 359), Prof. Stanley Gardiner directed attention to the serious effect of the German Reparations (Recovery) Act upon scientific workers and institutions in this country in regard to the duty of 26 per cent. on German publications; Prof. Gardiner at the same time protested strenuously to the Board of Trade. He has now received a reply in which the Board states that an Order has been made under section 5 of the Act referred to granting exemption from the levy in the case of certain periodical publications in the German language. The Order, which is dated February 16, reads:—"Any article of the following description shall be exempt from the provisions of the said Act—that is to say, any article being a publication in the German language which is proved to the satisfaction of the Commissioners of Customs and Excise to be a periodical publication of a German learned society or other scientific or philosophical periodical publication." Communication should be made with the Secretary, Custom House, Lower Thames Street, E.C.3, for particulars as to the manner in which to apply for the exemption of any particular consignment.

THE relatives of the late Sir Ernest Shackleton decided that the most appropriate burial-place for the dead explorer was the sub-Antarctic island of South Georgia, where he died and on which he performed the great feat of crossing the unknown ridge of mountains on his way from Elephant Island to the settlement of whalers in 1916. The body, which had been brought from South Georgia to Monte Video by Capt. Hussey, the meteorologist to the Shackleton-Rowett Expedition, was accordingly conveyed on board the British whaler *Woodville* at that port on February 15, the late explorer's birthday, and Capt. Hussey sailed with his old leader on the following morning. The Uruguayan Government, with characteristic sympathy and generosity, arranged the funeral procession as a State function, particulars of which appeared in the *Times* of February 16. The body in the rough wooden coffin made by the South Georgian whalers was taken to the English church in Monte Video, where the funeral service was read by Canon Blount. The coffin, placed on a gun-carriage and covered with the Union Jack and many wreaths, including one in bronze from the Uruguayan Government, was taken to the British Club, the British Chargé d'Affaires and many members of the British colony, including some from Buenos Aires, following. At the club the Uruguayan Minister of Foreign Affairs joined the procession, which moved on to the wharf accompanied by a guard of honour of Uruguayan Lancers, and the streets were lined with troops. At the wharf the Uruguayan War Minister delivered a sympathetic address, which was replied to by the British Chargé d'Affaires. When the *Woodville* sailed she was accompanied to the limit of territorial waters by the Uruguayan cruiser *Uruguay*, and on parting she fired a salute and ranged alongside the *Woodville*, with all hands lining the ship in farewell. The burial will take place on March 1, and a memorial service will be held in St. Paul's Cathedral on March 2.

A SOMEWHAT startling paragraph recently appeared in the *Times* giving an account of petroleum "divining" of an extraordinary nature by means of laboratory experiments carried out in France. Dr. Henri Moineau and M. Regis have apparently been at work on an apparatus for which it is claimed that by "harnessing Hertzian waves" the composition of subterranean solid, liquid, and gaseous matter may be indicated, quite irrespective of distance! Experiments are at present being carried out at the Puy du Dôme, in the Clermont-Ferrand region, and already this mysterious apparatus has detected petroleum deposits in Alsace, Saxony, Hanover, Czecho-Slovakia, Italy, the Rocky Mountains, the Allegheny Mountains, and finally in the Andes. No account whatever is given of the nature of the apparatus itself, though it is suggested that X-ray photography plays an important *rôle* in the determinations, particularly in the elucidation of underground structures. It is further alleged that with the apparatus it is possible to discern, not only oil, but also coal, minerals, and water occurring in remote parts of the world, the idea being that once such occurrences are located all that is necessary as a preliminary to successful boring is an aerial reconnaissance for the purpose of taking "X-ray photographs" of the selected areas. We cannot refrain from remarking that, although first impulse may dictate a dismissal of the matter as extravagant, present knowledge of electromagnetic wave propagation, though limited, is sufficient to promote realisation of possibilities, and caution before condemning prematurely their utilisation in the present connection.

AT a celebration which took place in the chemistry lecture theatre of the Sorbonne on January 22 Prof. Henry Le Chatelier was presented with a gold medal in commemoration of his fifty years' work of scientific and technical research. The chair was occupied by M. G. Noblemaire, president of the Comité Jubilaire, who recalled the various stages in the career of the illustrious *savant* and outlined the series of remarkable discoveries made by him, most of which have received important industrial applications. Eloquent speeches were also made by M. Molliard, dean of the Faculté des Sciences, and by M. Bertin, president of the

Académie des Sciences. Prof. Trasenster, representing the University of Liège, handed Prof. Le Chatelier the diploma of engineer *honoris causa* of the "Faculté Technique Wallonne." Surrounded by eminent men of science, engineers, and students, Prof. Le Chatelier, after thanking the members of the committee, declared that he was happy "to have been able to add a few links to the solid and durable chain of scientific discoveries, science being essentially a collective work, forged by the continuous and methodical labour of the *savants*."

THE search for the two missing men, Tessem and Knudsen, of Amundsen's Arctic Expedition who left the *Maud* in October, 1918, in the vicinity of Cape Chelyuskin carrying dispatches to Europe leaves no room for hope that they are alive. The *Times* of February 18 announces that Capt. Jacobsen, who has been searching the north-west coast of Siberia in the *Heimen*, found a note from the men near Cape Wild (long. 91° 30′ E.) to the effect that they arrived there in the middle of November, 1918, and found their provision depôt much damaged by sea-water, but that they were leaving under favourable conditions for Port Dickson, at the Yenisei mouth. Beyond Cape Wild, at a distance which Capt. Jacobsen does not specify, he found the remains of camp-fires and indications that a human body had been cremated. He believes that one of the men died there and that the survivor burnt his body lest it should be devoured by bears. No further traces were found.

THE first volume of the Dictionary of Applied Physics, of which Sir Richard Glazebrook is the editor, is announced by Messrs. Macmillan and Co., Ltd., for March, and the remaining four volumes may be expected before the end of the year. The successive volumes are to be devoted to mechanics, engineering, and heat; electricity; meteorology and metrology; optics, sound, and radiology; and metallurgy and aeronautics. The arrangement of the articles in all the volumes is to be alphabetical, and each article is written by a specialist. The list of contributors shows that the editor has succeeded in securing actual workers in each branch, and that the articles will therefore be thoroughly up to date. As the first attempt to place before the public in a convenient form the methods and results of recent research in applied physics, the Dictionary will be welcomed by all engaged in industries in which physics plays a part, as well as by scientific workers generally.

THE annual dinner of the Illuminating Engineering Society on February 10 aptly illustrated the variety of work with which the society is now concerned. Sir John H. Parsons, president of the society, presided. Sir Herbert Jackson, representing the Royal Society, proposed the toast of "The Illuminating Engineering Society," and Mr. J. B. Lawford (chairman of the Council of British Ophthalmologists) joined him in expressing appreciation of the programme of the society, notably in promoting discussion of the effect of light on the eye. The toast of "Kindred Societies" was proposed by Mr. F. W. Goodenough. Mr. T. Hardie (president of the Institution of Gas Engineers) and Mr. A. A. Campbell Swinton (vice-president of the Institution of Electrical Engineers and chairman of the Royal Society of Arts) pointed out how those associated with both forms of lighting had found a common interest in illuminating engineering. The toast of "The Guests" was proposed by Mr. L. Gaster. Mr. R. E. Graves (H.M. Chief Inspector of Factories) and Mr. William Brace (Mines Department), in responding, referred to the activities of the society in connection with industrial lighting and conditions of illumination in mines, and Mr. H. E. Blain emphasised the importance of good illumination in the interests of safety, both in relation to traffic and in industry.

THROUGH the generosity of the Fertilisers Manufacturers' Association and of the British Sulphate of Ammonia Federation, a special member has been appointed on the staff of the Rothamsted Experimental Station for the purpose of explaining the plots to farmers and others. Mr. H. V. Garner, of the School of Agriculture, Cambridge, has accepted the new post. The director, Dr. E. J. Russell, will now be glad, therefore, to arrange with secretaries of farmers' clubs, Chambers of Agriculture, and other bodies interested for visits to the plots. Among important items of interest are experiments on the manuring of arable crops, especially wheat, barley, mangolds, and potatoes; the manuring of meadow hay; the effect of modern slags and mineral phosphates on grazing land, hay land, and arable crops; crop diseases and pests; and demonstrations of good types of tillage implements, tractors, etc. At any convenient time between May 1 and October 1 there is sufficient to occupy a full day, and provision is being completed for assuring that the time shall not be lost, even if the weather turns out to be too bad to allow of close inspection of the fields.

IT will be remembered that Dr. Saleeby, writing in NATURE of December 8, p. 466, urged the importance of a co-ordinated inquiry into the action of sunlight in health and disease, under the auspices of the Medical Research Council. We are glad to see that the council has now appointed the following Committee to report upon the promotion of researches into the biological action of light with the view of obtaining increased knowledge of the effects of sunlight and other forms of light upon the human body in health or disease:—Prof. W. M. Bayliss (chairman), Mr. J. E. Barnard, Dr. H. H. Dale, Capt. S. R. Douglas, Sir Henry Gauvain, Dr. Leonard Hill, and Dr. J. H. Sequeira. Dr. Edgar Schuster is secretary of the Committee.

AT the monthly meeting of the Zoological Society of London held on February 15 twenty-four new fellows were elected to the society and thirty proposed for the fellowship. The secretary stated that the additions to the society's menagerie during January numbered 151—52 by presentation, 76 deposited, and 23 by purchase. The most important accessions included a Macedonian wolf (*Canis lupus*), a Dybowski's deer (*Cervus hortulorum*), eleven plumbeus quails (*Synaecus plumbeus*), and two angle

fish (*Pterophyllium scalare*), the last two species new to the collections. The report of the secretary recorded a considerable decrease in the number of visitors to the gardens in January as compared with the numbers of the corresponding month last year.

AT a meeting of the council of the National Institute of Agricultural Botany held on February 9 the first election of fellows of the institute took place. A hundred and ten candidates were elected, among whom were the following:—H.R.H. the Duke of York, the Prime Minister, the Duke of Bedford, the Marquess of Crewe, the Earl of Ancaster, the Earl of Derby, the Earl of Crawford, Viscount Milner, Lord Clinton, Lord Bledisloe, Lord Ernle, Sir Gilbert Greenall, Sir Harry Verney, Sir Matthew Wallace, the Hon. E. G. Strutt, the Right Hon. E. C. Pretyman, M.P., the Right Hon. Sir A. Griffith-Boscawen, Sir Thomas Middleton, Mr. Charles Adeane, Mr. Samuel Farmer, Mr. R. R. Robbins, and Lady Margaret Boscawen.

THE officers and other members of council of the Malacological Society of London for the ensuing year were elected on February 10 as follows:—*President:* Mr. A. S. Kennard. *Vice-Presidents:* Mr. J. R. le B. Tomlin, Prof. A. E. Boycott, Mr. G. K. Gude, and Mr. C. Oldham. *Treasurer:* Mr. R. Bullen Newton. *Editor:* Mr. B. B. Woodward. *Secretary:* Mr. A. E. Salisbury. *Other Members of Council:* Dr. A. H. Cooke, Mr. H. O. N. Shaw, Lt.-Col. A. J. Peile, Mr. T. Iredale, Dr. E. W. Bowell, and Mr. Hugh Watson.

ON Thursday next, March 2, Prof. H. M. Lefroy will deliver the first of two lectures at the Royal Institution on (1) "The Menace of the Insect Pest" and (2) "The Balance of Life in Relation to Insect Pest Control." On Saturday, March 4, Sir Ernest Rutherford will begin a course of six lectures on radioactivity. The Friday evening discourse on March 3 will be delivered by Dr. C. Morley Wenyon on "Microscopic Parasites and their Carriers."

DR. W. BATESON, director of the John Innes Horticultural Institution, Mostyn Road, Merton, S.W.19, is giving a demonstration of the genetics of *Primula sinensis* at the institution to-day, February 23, at 3 p.m. All interested in the subject are invited, and in particular those who attended Dr. Bateson's lectures on genetics in November last. Admission is free, without ticket.

THE ninth election to Beit fellowships for scientific research will take place in July next. Applications must be received by the Rector, Imperial College of Science and Technology, South Kensington, S.W.7, not later than April 19. Forms of application and all information respecting the fellowships are obtainable from the Rector of the Imperial College of Science and Technology upon written request.

THE first award of the Meldola medal, referred to in NATURE of January 12, p. 49, has been made by the council of the Institute of Chemistry, with the concurrence of Dr. Percy E. Spielmann, representing the Maccabæans, to Dr. Christopher Kelk Ingold.

Our Astronomical Column.

DETONATING FIREBALL IN SUNSHINE.—Mr. W. F. Denning writes that this object observed by him on February 7 at 3.55 p.m. appears to have been seen by comparatively few observers, although the loud detonations which followed it were heard by large numbers of people, chiefly in Warwickshire, over which county the fireball passed. It seems to have caused the loudest reports near the middle section of its flight, in the region of Quinton, Feckenham, Mere Hall, and Droitwich. At some places there was only one sound heard, at others two, but all the observers agree that the concussion and vibration were of startling intensity. The detonations were heard along a line directed from S.E. to N.W. The radiant point of the meteor was at 60°−11°, and the height from 56 to 32 miles; the length of luminous flight was 82 miles, and velocity about 10 miles per second. The position of the object was from over Oxfordshire to Shropshire.

MOVEMENTS IN SPIRAL NEBULÆ.—In this column for January 12 reference was made to the movements in spiral nebulæ which Dr. Jeans described at the Royal Astronomical Society when exhibiting slides sent by Dr. van Maanen. Dr. van Maanen has now published the fifth paper on this subject in the issue of the *Astrophysical Journal* for December last, showing the results of his investigation with regard to the spiral nebula Messier 81. This paper contains the evidence on internal motions derived from the four nebulæ which Dr. van Maanen has now measured, namely, M 101, 33, 51, and 81, and he summarises the results in a table of which the following is an abstract. The second column gives the interval in years between pairs of photographs he has compared, and the following four columns the motions as indicated at the heads of the columns. The last column gives the number of nebular points the positions of which were independently measured:—

(*Units for Motions* 0·001″.)

Object	Interval in years	Rotational	Radial	Stream	Transverse	No. of nebular points
M 101	5	+21	+ 5	+21	0	87
M 101	9	+20	+ 6	+22	− 3	69
M 101	15	+12	+ 7	+14	+ 2	46
M 33	10	+20	+ 6	+24	− 2	30
M 33	5	+14	+12	+18	+ 4	21
M 51	11	+19	+ 8	+21	+ 3	79
M 81	6	+20	+17	+25	+16	52
M 81	11	+38	+13	+39	+ 7	104

It will be seen that all pairs of plates show the same type of motion, and, as Dr. van Maanen points out, the agreement in the values of the motion for each nebula derived from different pairs of plates is as satisfactory as could be expected. In addition to the rotational components, which correspond to the periods in the order of the nebulæ in the table, namely, 85,000, 160,000, 45,000 and 58,000 years, they all show a large outward radial component. The close agreement of the displacements in direction with the spiral arms of the nebulæ suggests, as he states, "a realisation of the motions described by Jeans in 'Problems of Cosmogony and Stellar Dynamics.'"

Research Items.

JUVENILE DELINQUENCY.—In *Psyche* (vol. 2, No. 3) Dr. Cyril Burt discusses the causes and treatment of juvenile delinquency. In studying crime, he points out, we encounter at the outset the fact of multiple determination. Crime in any given person usually proves to be attributable, not to some one all-explaining cause such as "inborn criminality," but to a converging number of alternating factors. Usually some predominating factor can be singled out as chiefly responsible, which factor may be a legitimate label for classification, but in treatment it is never safe to deal with one factor only, however crucial it may be. In all cases it is necessary, for any scientific appreciation of the disturbance, to make a complete and comprehensive survey of the whole child and his surroundings; we must know the child's physical characteristics as well as its emotional and intellectual endowment. The author, while assigning a due position to mental defectiveness, does not support the view that all or most criminals are mentally defective. Various methods of diagnosis and of treatment are discussed. The article will be extremely valuable to all those who, whether from the point of view of theoretical psychology or of practical life, are interested in the individual and social consequences of delinquency.

CRANIOMETRY IN THE BRITISH ISLES.—Prof. F. G. Parsons has done good service to anthropometry by collecting in the February issue of *Man* all the available records of the cephalic index to be found in these islands. The record of 3000 criminals is of special interest, as they show the very high cephalic index of 785, and the size of their heads is very low. This suggests that our recent immigrants from Central Europe have contributed even more than their fair share of crime. It is also remarkable that the average index of a group of Cambridge students is 796 as compared with the Oxford average of 780; possibly some mistake has crept into the arithmetic, but the question deserves further investigation. Other interesting deductions from these figures are that the average head-shape of people in England differed very little between Saxon times and the eighteenth century, the trifling variations being probably due to immigration from the Continent; and that these records do not supply any reason to believe that the size of the modern Englishman's head is increasing with its increasing rotundity; in fact, both the Saxons and the Long Barrow folk, from the fusion of whom most of our blood is derived, seem to have had rather larger heads than the average modern Englishman, and there is no reason to believe that physically they were larger men. Unfortunately, these records, confined to the cephalic index, take no account of head height, which is a serious loss. Further, this collection, large as it is, is inconclusive when compared with a population of some forty millions. In the past, as, for instance, in India, the evidence from craniometry has led to unfounded theories because the number of the subjects was insignificant as compared with the total population. If it is to succeed in justifying its claims, provision must be made for a much larger number of measurements, and these must not be confined to the cephalic index.

SAFFLOWER-SEED OIL.—Bulletin 124 of the Agricultural Research Institute, Pusa, contains an account of safflower oil. Safflower (*Carthamus tinctorius*, L.) is widely cultivated in India, both as an oilseed and, to a much smaller extent, for the reddish dye (carthamin) in the flowers. The crop is extensively grown in the driest areas of the Deccan for its oil-seed. The oil is edible when clarified, and is used as an adulterant for butter. The sweet-oil of Bombay is made by mixing safflower, earth-nut, and *til* seeds and expressing the oil. After boiling, safflower oil forms a gelatinous mass, and it is a drying oil. This form is used as "roghan," or Afridi wax, for the preparation of wax-cloth. The oil is also suitable for the manufacture of soap. It is suggested that safflower-seed oil could become a valuable commercial product on the home markets.

DATE CULTIVATION IN THE 'IRAQ.—Under the auspices of the Agricultural Directorate, Ministry of the Interior, Mesopotamia (Memoir 3, 1921), Mr. V. H. W. Dowson has published a very interesting and valuable report on date cultivation on the Shat el Arab, the river which conveys to the Persian Gulf the joined waters of the Euphrates and the Tigris. The Shat el Arab is the most important area of date cultivation in the world; both banks are lined with date-gardens for a distance of 108 miles, with an average width on either side of about a mile, representing about 138,000 acres. In the 'Iraq the date-palm flourishes wherever it is watered and cared for, from Ana on the Euphrates and Samara on the Tigris southwards; north of these towns the winters are too cold. Mr. Dowson describes in detail the methods of cultivation and marketing, and also enumerates the chief uses of the palm and its products—in the last instance he refers to an old Tamil song which enumerates eight hundred and one uses of the Palmyra palm, and remarks that the number of uses of the date-palm and its products is probably but little short of this number. Compared with many fruit-trees, the date-palm suffers but little from disease; its one important enemy is the larva of a Gelechiid moth, the adult of which is unknown. Preventive measures against the ravages of this pest, which causes the young green dates to turn brown and drop to the ground, have still to be devised. In a second part of the memoir the author gives a statistical summary of his investigation into the yield of the different varieties, and in a third part (in preparation) he will deal generally with the varieties of date-palms of the 'Iraq, which includes also the Bagdad area, the next largest date-cultivation centre in the country, comprising about twenty miles of date-gardens lining both banks of the Tigris. The memoir is illustrated with numerous photographic reproductions.

BRITISH MYCOLOGICAL SOCIETY.—In pt. 3 of vol. 7 of the Transactions of this society Mr. Petch, of Ceylon, continues his studies in entomogenous fungi, writing learnedly of the Nectriæ parasitic on scale insects. A number of new species are described, but it is very unfortunate that no cultural data are given. An interesting account of the recently founded Imperial Bureau of Mycology, with a suggestive *résumé* of its functions, is contributed by the director, Dr. E. J. Butler. The establishment of this bureau is somewhat of an epoch-making event in phytopathology, and all support possible should be rendered to it. Messrs. Brooks and Searle give an account of the fungi responsible for certain tomato diseases, emphasising what should be so obvious: the necessity of cultural data in specific determinations. There are also an interesting paper by Miss Mounce on homothallism and the production of fruit-bodies by

monosporous mycelia in the genus Coprinus, and a note by Mr. Collet describing viability in *Fumago vagans* after sixty-seven years' preservation as a herbarium specimen. The issue is well produced and illustrated by five plates, two of which are beautifully coloured.

SILICIFIED PLANT REMAINS.—The Middle or Lower Devonian flora discovered by Dr. Mackie at Rhynie, in Aberdeenshire, was generally reviewed by Prof. F. O. Bower in 1920 (NATURE, vol. 105, pp. 681 and 712). Dr. Kidston and Dr. W. H. Lang (Trans. Roy. Soc. Edin., vol. 52, pt. 4, 1921) now describe the thallophytes occurring in the remarkable silicified peat-bed, and discuss the conditions of accumulation. The sequence is due to continued growth on a land-surface that was at times submerged in lake-waters impregnated with silica. A volcanic source is suggested for the silica, and it is pointed out that the growth of cyanophaceæ and bacteria in modern hot springs is known to promote a deposition of colloidal silica. We may note that Prof. W. N. Benson (Proc. Linn. Soc., New South Wales, vol. 45, p. 315, 1920) refers the silicification of remains of gymnosperms in Carboniferous beds on Mount Cobla, New South Wales, to contemporaneous hydrothermal solutions associated with the deposition of keratophyric tuffs. In view of climatic changes in the past, the possibility of the spread of siliceous waters derived from laterisation must not, of course, be overlooked.

AUSTRALIAN METEOROLOGY.—Meteorological statistics for the Australian Colony of Victoria have recently been published, based on all the available records obtained at 1046 official stations from January, 1856, to December, 1907. They have been prepared under the direction of Mr. Pietro Baracchi, Government Astronomer from 1895 to 1915. Observations were commenced at Melbourne in 1840 and continued until 1851, when, in consequence of Government changes, there seems to have been a break for about four years. From 1855 observations were made at Melbourne and at some twenty stations in different districts of the Colony. All observations were controlled by the authorities at Melbourne Observatory until 1907, when the meteorological duties were taken over by the Government of the Commonwealth of Australia under the control of the Commonwealth Meteorologist, Mr. H. A. Hunt. The observations included in the volume received are a summary of results to 1907, when the responsibility of Melbourne Observatory ceased. This volume of the early Australian weather observations is of great value as affording data for seasonal changes and possibly showing meteorological irregularities of interest in connection with more recent observations. A detailed history is given of the development of the system of observing and showing the requirements and value of meteorological observations, especially a thorough knowledge of rainfall distribution. Many details given in the introduction are of extreme value, and show most thorough supervision and great alertness as to the utility of special observations. At Melbourne observations are given for a period of fifty years. The mean and extreme values for the several elements and for the different regions of observation are of high scientific value.

STANDARD CELLS OF LOW VOLTAGE.—In the issue for November, 1921, of the Proceedings of the Physico-Mathematical Society of Japan Mr. J. Obata describes the investigation he has carried out on the possibility of constructing standard cells of low voltage for testing purposes. Nine types of cell have been studied, in all of which cadmium or cadmium amalgam formed the negative, and cadmium or lead amalgam the positive pole. The electrolytes were solutions of lead or cadmium sulphate, chloride, bromide, or iodide, and the cells were given the H form. The two cells which proved most suitable for standards were the cadmium amalgam/cadmium iodide/lead iodide/lead amalgam cell with an electromotive force at 20° C. of 0·09838 volt and a temperature coefficient of 0·00024 volt per degree, and a cadmium amalgam (10 per cent.)/cadmium sulphate solution/cadmium amalgam (dilute) cell with an electromotive force of about 0·01 volt and a temperature coefficient of about 0·0004, according to the strength of the dilute amalgam.

MAGNESIUM IN ORGANIC CHEMISTRY.—Mr. H. Hepworth describes in the issue of the Journal of the Society of Chemical Industry for January 16 the recent applications of magnesium in organic chemistry. The "Grignard reaction," since its discovery in 1900, has found numerous applications in organic synthesis, and this paper is an interesting *résumé* of much recent work. The following examples will serve to illustrate the new lines of research made possible by the use of magnesium compounds. *Cyclo*pentamethylstannines, in which the ring contains an atom of tin replacing carbon, have been obtained. Tin diaryl-compounds exhibit an intense colour. Lead tetra-alkyls, lead triaryls, apparently analogous to triphenylmethyl, and mixed tin and lead compounds have been prepared, and *l*-phenylchloroacetic acid is converted by magnesium phenyl bromide into *d*-diphenylsuccinic acid. The use of ether in preparing the Grignard reagent is not essential, but the early view that an additive compound was formed seems to have received confirmation by the isolation of a crystalline compound, $2(C_7H_7)_3PO,CH_3MgI$, when tribenzyl phosphine oxide is used instead of ether, and of crystalline $(C_5H_{11})_2O,MgCH_3I$ with amyl ether. Instead of the oxonium structure for such compounds, a formula in which magnesium is the central atom with co-ordination number 4 has been proposed, the ether being attacked by subsidiary valencies.

VIBRATIONS OF VEHICLES.—According to an article by M. A. Boyer-Guillon in the November issue of the Bulletin of the Société d'encouragement pour l'Industrie nationale, the Auclair and Boyer-Guillon accelerometer is to be used in the near future in a detailed study of the oscillations, shocks, or vibrations to which the rolling stock of the French railways is subjected. The Automobile Club of France and the Society of Architects propose also to use it in a study of the vibrations of buildings. The instrument has already led to the solution of problems connected with the failure of machines apparently well designed for the stresses they were expected to withstand. In most cases it has shown that the accelerations to which parts of the machines were subjected were far in excess of those contemplated. Used on autocars in Paris streets it gives the vertical accelerations on irregular wood and on good stone pavements as between 6 and 7 metres per sec. per sec. at a speed of 27 km. per hour. The instrument itself consists of a heavy mass held up by springs attached to the ends of rods which project radially from it. The springs are of graduated strengths, and each holds the rod to which it is attached against a stop with which it makes electrical contact until the down acceleration breaks the contact, and the break is registered on the revolving drum of a chronograph.

The Standardisation of Radium Ampoules for Therapeutic Use.

AN apparatus for the routine standardisation of ampoules containing radium compounds and emanation by the γ-ray ionisation method was installed recently at the Institut Curie. It consists, as shown in Figs. 1 and 2, of a screened ionisation chamber A connected directly to a gold-leaf electroscope B. The ampoule to be tested is placed in an aluminium tray on the support C, which can be slid along a graduated rule D. The intensity of the ionisation current is deduced from the rate of fall of the gold-leaf.

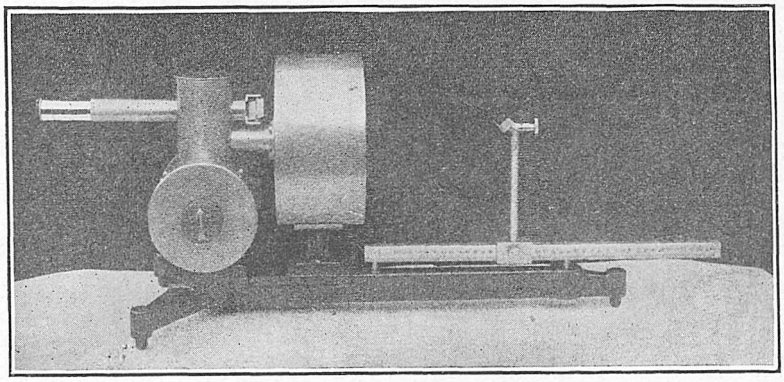


FIG. 1.—Apparatus for the standardisation of radium ampoules (one-tenth full size).

A novel feature of the apparatus is the method of charging the electroscope by means of a variable multicellular condenser E, which obviates the need for a high-voltage battery.

The fixed plates of the condenser are connected to the frame, whilst the movable plates are mounted on a spindle actuated by an ebonite knob. When the condenser is in the position of maximum capacity a projecting finger F brings the movable plates momentarily into contact with the stem H, to which is connected a low-voltage battery (10–20 volts). On turning the movable plates through 180° the same finger comes into contact with another stem J connected to the electroscope; at this instant the capacity of the condenser is at its minimum and the potential proportionately increased (about thirty times).

The gold-leaf is observed by means of a microscope K the eyepiece of which is fitted with an angular scale; a small mirror L serves to illuminate the field of the microscope. The ionisation chamber consists of a cylindrical brass box containing a thin aluminium disc M, which is connected to the electroscope through the amber-insulated rod N. The end of the box facing the ampoule is closed by a screen consisting of two lead plates each 5 mm. thick.

A modification of the apparatus is used for measuring the radio-activity of ores, earths, etc. The electroscope, the charging condenser, and the substance to be tested occupy separate compartments of a cylindrical brass box. The radio-active substance is placed on a tray immediately underneath a rounded stem, the upper end of which forms the pillar of the electroscope. The latter is charged by means of a variable condenser identical with the one previously described, but it can, if desired, be charged independently or connected to a separate ionisation chamber.

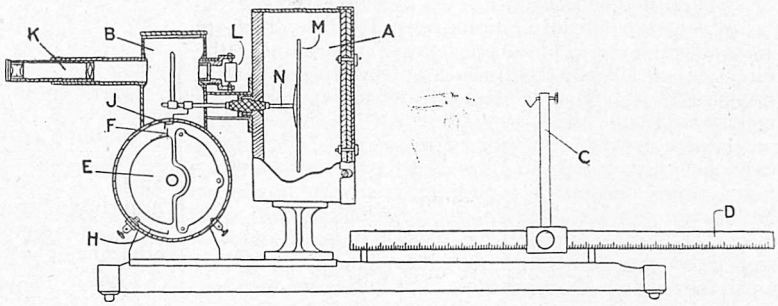


FIG. 2.—Sectional view.

The electroscope is "earthed" by turning a milled head.

Both instruments were designed by M. Holweck, of the Institut Curie, in collaboration with the manufacturer, M. Beaudouin, Paris.

Life-cycles of Bacteria.

IN a preliminary communication published in 1916 Dr. Löhnis expressed the view that all bacteria pass through a definite life-cycle, and the present publication [1] is an extensive review of the literature in support of that contention. The volume also includes a chapter on methods, an extensive bibliography, and more than 350 microphotographs of the forms observed.

Briefly, the life-cycle is as follows:—Under certain conditions the cells come together and fuse, forming an amorphous mass—the symplastic stage—in which the protoplasm undergoes a thorough mixing. The symplastic stage is formed not only in cultures in artificial media, but, in the case of the pathogenic organisms, in the body of the host as well. It forms the connecting link between the various sub-cycles of which the life-cycle of the organism may be composed. All kinds of vegetative cells, as well as all the varieties of reproductive organs described by the author, can give rise to the symplastic stage. From the symplasm the so-called regenerative units always arise, and these either grow into new cells or several of them unite to form new cells directly.

Six distinct types of reproductive organs have been described by the author. These are:—(1) Gonidia, two to four or more in each cell. They are generally motile and slightly more resistant than vegetative cells. Many are filter passers. They grow into vegetative cells. (2) Regenerative bodies, distinct from regenerative units. They are spherical, oval,

[1] Part 1, Review of the Literature (1838–1918). By Dr. F. Löhnis. National Academy of Sciences, Washington, vol. 16, second Memoir. Pp. 252+41 plates.

pear- or kidney-shaped or more or less irregular, rod-shaped, and branched. They are readily stainable, generally motile, and fairly resistant. They may multiply by fission or budding, are formed from vegetative cells or from the symplasm, and may give rise to vegetative cells or to the symplastic stage. (3) Exospores, unstainable regenerative bodies. (4) Endospores, produced by vegetative cells or by regenerative bodies. Conditions for formation are similar to those for the formation of regenerative bodies. (5) Arthrospores, easily stainable, but withstand drying better than heating. They are formed by the segmentation of vegetative cells and transformation of the joints into fairly resistant spherical bodies. (6) Microcysts, very similar to arthrospores. They are formed by vegetative cells growing and becoming spherical with a thickened membrane. After a rest period they may become vegetative cells, germinate like spores, or may break up into two, three, or four segments, which become vegetative cells. In addition to their reproductive function exospores, endospores, arthrospores, and microcysts are, in the first place, resting-stages.

Besides the formation of the symplasm a second mode of interaction between the protoplasmic bodies in bacterial cells has been observed. This consists in the union of two or more cells, and is termed "conjunction" by the author. Conjunction is most common in cultures two to four days old, and generally precedes the formation of gonidia, reproductive bodies, exospores, and endospores.

The publication brings together an overwhelming amount of evidence as to the existence of the various forms distinguished by the author. The arrangement of these forms in the life-cycles of the bacteria is a point on which further information is desirable, but this will, doubtless, be provided in the later publication in which the observations of the author are to be dealt with in detail. From the point of view of the student of bacterial morphology the publication must be regarded as one of first-rate importance. The general worker on bacteriological problems will also find in it much information of a highly valuable nature, and doubtless will be able to confirm the existence of many of the forms observed from the results of his own experience.

Miners' Lamps.[1]

OF late years there has been a tendency on the part of makers of miners' safety lamps to employ thin sheet-metal, perforated with holes of small diameter, to serve the same purpose as wire gauze—that is to say, with holes large enough to admit of the passage of the necessary volume of air through them, but small enough to arrest the passage of flame. It will be recalled that the lamp invented by George Stephenson depended upon perforated sheet-copper for its impermeability to flame. A further innovation that has recently been gaining ground is the addition of a short glass cylinder, known as the "combustion tube," to the lower end of a metal chimney suspended directly above the flame of the lamp. This contrivance promotes a better circulation of air in the lamp, keeps the products of combustion separate from the incoming air, and, as a consequence, produces a brighter flame and enhances the lighting power of the lamp.

Metal chimneys have long been employed with this object, notably in the Mueseler lamp—the only kind of safety lamp permitted in Belgian mines—but as the bottom of the metal chimney cannot be brought lower down than the top of the flame without obstructing the light, the benefit derived from their use is limited. In this respect the glass extension is distinctly beneficial.

Having regard to the changes of this kind which were taking place in the construction of safety lamps, the Home Secretary appointed the Miners' Lamps Committee in 1919 to inquire into, and report on, various questions relating to safety lamps, and the Secretary for Mines re-appointed the same Committee in January, 1921. Up to the present the Committee has issued five Memoranda, of which the last two, Nos. 4 and 5, issued in the end of last year, deal with the use of perforated metal plates and chimneys respectively.

The experiments described in Memorandum No. 4 were made to ascertain the relative resistance to the passage of flame possessed by metal plates of various thicknesses perforated with holes of various diameters; and those described in Memorandum No. 5 to ascertain the relative resistance of chimneys of various lengths and diameters at top and bottom and extending to higher or lower levels above and below the wire gauze diaphragm by which they are supported.

The results are tabulated in both memoranda and in the letter to the Secretary for Mines which accompanies each the chairman of the Committee makes certain recommendations and suggestions founded on these results. The total cost of the Committee's inquiry to date (November, 1921) is given as 5550*l*.

[1] Mines Department. Miners' Lamps Committee. Memorandum No. 4: Record of research on the passage of flame through perforated plates and through perforated tubes of small diameter. Pp. 12+6 plates. (H.M.S.O.) 9*d*. net. Memorandum No. 5: Record of research on the passage of the flame of an explosion from within miners' lamps fitted with chimneys. Pp. 12. (H.M.S.O.) 6*d*. net.

Pébrine in Silkworms.

IN an interesting report on pébrine in silkworms in India (Memoirs Dept. Agric. in India, Bacteriological Series, vol. 1, No. 8, November, 1920, pp. 75, 26 plates), Mr. C. M. Hutchinson gives an account of experimental work on methods of infection. He found infected ova in the pupal ovary, and the infection is traced in the egg, larva, and pupa—and recounts the life-history of the causal organism, *Nosema bombycis*. The Pasteur method of searching for the organism, devised more than fifty years ago, consists in crushing the body of the moth in a mortar, and examining, under a magnification of about 600, a small fraction of the resulting powder in a drop of water, to ascertain if the characteristic spores of Nosema are present. This method, according to the author, has not been attended in India with any approach to the measure of success which has been attained in Europe. The chances of non-detection of infected moths, and the risk of spreading the spores (due to careless application of the method) in the rooms used for examining the moths, are considerable—the author states that he has seldom failed to find Nosema spores in the floor dust from these rooms, even in cases where the floors were of concrete. In Europe a period of several months elapses between oviposition by the moth and hatching of the eggs, so

that the examination of the moths can be undertaken when they have undergone natural desiccation, and the Nosema, if present, is likely to be in the form of the readily recognisable spores. In India the eggs hatch out within eight days after they are laid, and during this period all the moths must be examined. Rapid desiccation prevents the Nosema forming spores, and the number of spores present in a rapidly dried moth may be so small as to escape detection by the Pasteur method. The author's revised method, depending on the fact that infection is chiefly in the chyle stomach, is to remove with needles a portion of this organ to a slide, rub it up in water, and examine it microscopically. Incidentally he remarks on the inefficiency of the copper sulphate solutions usually employed for sterilising rearing houses and appliances in Bengal, but he found that formaldehyde, employed as vapour or in 1 per cent. solution, completely destroyed the infective power of Nosema spores. A hopeful line of inquiry seems to be opened up by experiments which indicate that resistance to infection is increased by hill rearing.

University and Educational Intelligence.

BIRMINGHAM.—A post-graduate course of lectures on "Medical Aspects of Crime and Punishment" has been arranged.

The council of the University has appointed Mr. Alfred Piney to be lecturer on pathological histology.

Acting on the recommendation of the Senate, the council has approved of the following grants in aid of research for the current year:—Physics, 100*l.*; chemistry, 250*l.*; and zoology, 200*l.*

The Vice-Chancellor, Treasurer, Principal, and Vice-Principal have been appointed representatives of the University for the Conference of Universities to be held in London on May 13 next.

CAMBRIDGE.—On the recommendation of the General Board of Studies it has been decided that Mr. C. G. Lamb shall be appointed reader in electrical engineering, and that, subject to confirmation by the Special Board for Mathematics, Sir Gerald Lenox-Conyngham shall be appointed reader in geodesy.

It is proposed to confer the honorary degree of Sc.D. upon Baron A. A. A. von Hügel, Trinity College, late curator of the Museum of Archæology and Ethnology.

A visiting fellowship of the annual value of 2000 dollars, tenable for not more than three years, has been founded at Princeton University by Mr. William Cooper Procter for residential study and investigation in the Graduate College of Princeton University. An unmarried male graduate who is a citizen of this country, and not more than thirty years of age, is eligible for appointment, and the visiting fellow must give himself wholly to study and investigation in one of the purely liberal arts and sciences while holding the fellowship. Applications must be made to the Vice-Chancellor not later than the end of March.

It is notified that the Royal Commission for 1851 has decided to establish certain senior studentships of the value of 400*l.* a year, for which nominations may be made by the University of Cambridge, amongst others. Applications will be made through the professor or head of a laboratory or department under whom the candidate has already carried out research.

The Royal Agricultural Society has offered for the Agricultural School at Cambridge the income of the Hills Bequest for the investigation of the value and uses of the rarer forms of ash in the cultivation of crops.

LEEDS.—The council of the University has appointed Mr. A. Wormall demonstrator in biochemistry.

LONDON.—The following doctorates have been conferred:—*Ph.D.* (*Science*): Mr. H. T. Flint, for a thesis entitled "Integration Theorems of Four-dimensional Vector Analysis"; Mr. R. J. Ludford, of University College, for a thesis entitled "Studies in Gametogenesis: Pt. 1, Contributions to the Study of the Oogenesis of Patella, containing the Mitochondria and Gogli Apparatus in relation to Vitellogenesis in Patella; Pts. 2 and 3, Dictyokinesis in Germ-cells, and the Gogli Apparatus during Cell-division"; Mr. H. Moore, for a thesis entitled "The Season-cracking of Brass and other Copper Alloys"; and Mr. S. H. Tucker, for a thesis entitled "Carbazole."

ST. ANDREWS (UNITED COLLEGE).—The Gray prize in logic for an essay on Kant's "Deduction of the Categories" to Mr. Norman McLeish, and the Tyndall Bruce logic prize for an essay on "The Conception of Substance" in Descartes, Locke, Berkeley, and Hume to Mr. Norman McLeish.

THREE fellowships, each of the yearly value of 200*l.*, tenable for two years, are offered by the University of Wales to graduates of that University. Information respecting the fellowships can be obtained from the Registrar, University Registry, Cathays Park, Cardiff. The latest date for the receipt of applications for the fellowships is May 31 next.

MR. L. P. W. RENOUF, assistant lecturer in zoology in the Technical College, Bradford, has recently been elected to the professorship of zoology in University College, Cork. Prior to his appointment at the Technical College, Mr. Renouf was lecturer and examiner in zoology in the University of Glasgow and director of the Bute Laboratory and Museum.

THE annual general meeting of the Association of Technical Institutions will be held at the Leathersellers' Hall, St. Helen's Place, London, E.C., on Friday and Saturday, March 3 and 4. On the Friday morning the president, Viscount Burnham, will introduce the president-elect, the Right Hon. Walter Runciman, who will deliver an address. Papers to be presented are:—"Diplomas," Dr. Clay; "Certificates for Evening Students," Principal Hogg; and "A Mechanical Engineering Diploma," Brig.-Gen. Mowat. Sir Alfred Keogh, Rector of the Imperial College of Science and Technology and a past-president of the association, will attend the meeting on Friday afternoon and speak on the subject of diplomas for higher technical education and work of a university standard.

THE report for 1921 of the Association of Science Teachers contains the findings of a sub-committee appointed to consider the new regulations relating to the examination for the clerical class of the Civil Service. Referring to the science syllabus, the committee is of opinion that, in view of the fact that pupils of secondary schools are expected to take the First School Examination at the age of 16½ years, it is to be regretted that the science syllabus in the Civil Service regulations is not more in accordance with that adopted for the First School Examination; further, that teaching along the lines laid down in the new Civil Service syllabus would tend to the acquisition of a superficial knowledge of useful facts in modern science without necessarily affording a training in scientific method. The report also includes an account of the general meeting of the association held in London on January 3 last, and referred to in NATURE of January 12, p. 57.

Calendar of Industrial Pioneers.

February 23, 1860. Joseph Miller died.—Trained as a mechanical engineer at Boulton and Watt's, Miller in 1822 with Barnes established one of the most successful marine engineering works on the Thames. He was a promoter of screw propulsion, and for H.M.S. *Amphion* built the first set of direct-acting screw engines placed below the water-line.

February 24, 1815. Robert Fulton died.—Famous as the pioneer of steam navigation in the New World, Fulton was born in 1765, and in early life attained success as an artist. Afterwards in England and France he turned to mechanical pursuits; in 1800 he constructed a submarine, and in 1803 experimented with a steamboat on the Seine. He returned to America in 1806, and the following year built the *Clermont*, which, driven by an engine constructed by Boulton and Watt, ran successfully between New York and Albany. Among other vessels built by him was the *Demologos*, the first steam man-o'-war.

February 24, 1875. Marc Seguin died.—A nephew of the aeronaut Montgolfier, Seguin was the first to construct an iron-wire suspension bridge and one of the earliest of French railway engineers. In 1827 he invented the tubular boiler, and the same year applied it to a locomotive for the railway from St. Etienne to Lyons. He also made scientific investigations and endeavoured to develop the mechanical theory of heat.

February 26, 1834. Alois Senefelder died.—The inventor about 1798 of the art of lithography, Senefelder, who in his youth was connected with the stage, was led to his discovery through seeking for a cheap method of reproducing his comedies. He established a lithographic establishment at Munich, and afterwards was Director of the Bavarian Royal Lithographic Office.

February 27, 1794. Jean Rudolphe Perronet died.—Perronet has been called the Telford of France. From the office of the City Architect of Paris he entered the Government service, and in 1747 became the first director of the Ecole des Ponts et Chaussées founded by Trudaine. He was the first to introduce bridges with level roadways, and among his most notable works was the bridge across the Seine at Neuilly.

February 27, 1913. Sir William Henry White died.—From an apprentice at Devonport Dockyard White rose to be Chief Constructor of the Navy, a post he held from 1885 to 1902. During this period he was responsible for the construction of 245 vessels costing about 100,000,000*l*. A great master of his profession, he added much to the literature of naval architecture, held the presidencies of various technical societies, and was instrumental in forming the Royal Corps of Naval Constructors.

February 28, 1875. Sir Goldsworthy Gurney died.—One of the pioneers of the steam road carriage, Gurney practised as a surgeon at Wadebridge and then in London. He was the inventor of the Drummond light, the steam blast, and a water-tube boiler, and in 1829 went from London to Bath in a steam-driven carriage at 15 miles an hour.

March 1, 1911. Robert McAlpine died.—McAlpine is regarded as the father of wood-pulp paper. Emigrating from Scotland to Massachusetts at the age of sixteen, he mastered the business of paper-making, and in 1867 produced the first sheet of paper made from ground wood-pulp, the initial step in the production of abundant supplies of cheap paper.

E. C. S.

Societies and Academies.

LONDON.

Royal Society, February 16.—Sir Charles Sherrington, president, in the chair.—L. **Hill**, D. H. **Ash**, and J. A. **Campbell**: The heating and cooling of the body by local application of heat and cold. When the hands are heated or cooled by water the amount of heating or cooling is large, but not constant for a given range of temperature. The degree of heating or cooling is obtained from the temperature of the skin over the median vein at the elbow, the thermometer used being coiled and insulated from the air. Loss of 20 to 25 kilo-calories of heat from the hands in thirty minutes, *i.e.* a loss almost equal to the basal metabolism, does not appreciably affect the body metabolism.—J. B. **Cohen**, C. H. **Browning**, R. **Gaunt**, and R. **Gulbransen**: Relationships between antiseptic action and chemical constitution, with special reference to compounds of the pyridine, quinoline, acridine, and phenazine series. Certain acridine derivatives, salts of diamino-acridine and the methochloride of this base, are extremely potent antiseptics. Pyridine and quinoline derivatives ("fragments" of the acridine molecule), a number of acridine derivatives, and some phenazine compounds were also investigated, but none approximate to diamino-acridine in antiseptic properties. Dealing with the acridine group, the presence of amino-groups increases antiseptic power, and effectiveness in serum is a characteristic of compounds with unsubstituted amino-groups, and especially of their methochlorides. Other radicals replacing the methyl group in the methochloride do not alter the antiseptic action, but substitution of alkyls in the amino-group tends to diminish antiseptic action, while acetylation or replacement of the amino-group destroys it. Antiseptic action on organisms of different types shows marked irregular variation.—D. T. **Harris**: Active hyperæmia. The lingual nerve contains true vaso-dilator and the sympathetic vaso-constrictor fibres; both are equally independent of the intervention of metabolites. Experiments show that increased blood-supply during muscular activity is due entirely to the products of metabolism, and of the metabolites estimated carbon dioxide and α-hydroxy organic acids were increased. Vaso-dilator nerves are concerned with the control of body temperature; active hyperæmia in the dog's tongue may be induced by reflex excitation of the vaso-dilator nerves through the stimulation of heat receptors in the skin.—B. B. **Sarkar**: The depressor nerve of the rabbit. The depressor nerve of the rabbit is connected in part with a special collection of ganglion-cells in the vagus, distinct from the ganglion of the trunk, which may extend into the superior laryngeal or the vagus trunk. These cells probably give rise to the afferent fibres of the depressor. The nerve is usually formed by two branches, one from the superior laryngeal and one from the vagus, and is connected with the inferior cervical ganglion, the root of the aorta, and the base of the heart. The left nerve of the pair is generally larger and contains more fibres than the right. The depressor contains medium-sized and very fine myelinated fibres, and others which are non-myelinated. Probably it is not wholly formed of afferent fibres, for these fine myelinated and non-myelinated fibres presumably belong to the autonomic nervous system and are efferent.—A. **Lipschütz**, B. **Ottow**, C. **Wagner**, and F. **Bormann**: The hypertrophy of the interstitial cells in the testicle of the guinea-pig under different experimental conditions. Partial castration often causes enormous hypertrophy of the interstitial tissue. This hypertrophy is not compensatory, for the tendency to

hypertrophy of interstitial cells is more marked in fragments with improved blood-supply. Hypertrophy appears to be independent of the internal secretory function of the testicle in its relation to the organism as a whole, and is a response to local conditions.

Linnean Society, February 2.—Dr. A. Smith Woodward, president, in the chair.—F. **Johansen**: The Canadian Arctic Expedition of 1913–18. The expedition started from Vancouver in the *Karluk* for Nome, in Alaska, where the equipment was procured. One party, under Mr. Stefansson, on the *Karluk* was caught in the ice in September, 1913, and carried westward until the vessel sank, in about 73° N. lat. and 160°–165° W. long. The party camped on an ice-floe, and the survivors reached Siberia in March, 1914, and Nome in May. Stefansson later organised a new search-party to proceed by sledge across Banks Land; he explored Parry Islands, discovering coal in Melville Island. Coasts hitherto unmapped were surveyed, and much geological and biological material was gathered, as well as many implements used by Esquimaux.—J. C. **Willis** and G. U. **Yule**: Some statistics of evolution and geographical distribution in plants and animals and their significance. The general result seems to show that evolution and geographical distribution have proceeded in a chiefly mechanical way, the effects of the various "other" factors that intervene—climatic, ecological, geological, etc.—being only to bring about deviations this way and that from the dominant plan. Every family and every genus, and in every country, behaves in the same way. Strong evidence is thus given for de Vries's theory of mutation and for Guppy's theory of differentiation (see NATURE, February 9, p. 177).—Mrs. E. M. **Reid**: Note on the hollow curve as shown by Pliocene floras. The material was that published from Tegelen, Castle Eden, etc. Fossil floras take their appropriate place alongside living floras, bringing direct evidence from the host to show the universality of the law of hollow-curve distribution.

Aristotelian Society, February 6.—Prof. Wildon Carr in the chair.—A. H. **Hannay**: Standards and principles in art. The problem of standards and objectivity in art is usually debated on the basis of standards and objectivity or no standards and subjectivity. Each new and individual work of art carries with it its own individual and original awareness. This view does not necessitate a lapse into subjectivism if it is realised that the awareness or taste is itself a striving for objectivity and rightness. The search for standards is the outcome of this incessant quest for right taste. Beauty is not entirely unique and indefinable. It is a process, a constructing, and can be differentiated from other processes such as history, science, and philosophy. Actually, modern criticism is full of psychological analyses which definitely involve reflective principles, but they are distinct from the old standards, for they do not pretend to anticipate the individual content of works of art. But do they precede, accompany, or follow upon æsthetic creation and appreciation? It is accepted that they are a later product, and this view has been stated very lucidly by Benedetto Croce. Yet history does not confirm it, and it does not explain the fact that criticism clarifies taste. It is suggested that the process imagination-principle is not a passage from one independent activity to another, but a development which requires both activities and in which a modification in one means a modification in the other. The critic emphasised the universal element, while the artist emphasised the individual element.

Zoological Society, February 7.—Dr. A. Smith Woodward, vice-president, in the chair.—C. W. **Hobley**: The fauna of East Africa and its future. Special attention was directed to the need for immediate action to preserve the herds of big game from total extinction.—Miss L. E. **Cheesman**: The position and function of the siphon in the amphibious mollusc *Ampullaria vermiformis*.—J. **Stephenson**: Contribution to the morphology, classification, and zoogeography of Indian Oligochæta. IV.: The diffuse production of sexual cells in a species of Chætogaster (fam. Naididæ). V.: *Drawida japonica*, Michlsn., a contribution to the anatomy of the Moniligastridæ. VI.: The relationships of the genera of Moniligastridæ, with some considerations on the origin of terrestrial Oligochæta.

Physical Society, February 10.—Dr. A. Russell, president, in the chair.—E. A. **Owen** and Bertha **Naylor**: The measurement of the radium content of sealed metal tubes. Tables have been compiled giving the corrections to be applied to the observed radium content of sealed platinum and silver tubes to obtain their true radium content. Two cases have been considered: (*a*) that in which the active deposit is uniformly distributed throughout the volume of the tube, and (*b*) that in which the active deposit is uniformly distributed over the inner wall of the tube. With constant wall-thickness the correction increases with the external diameter of the tube, and for the same increase of external diameter the increase of correction is more pronounced for the "empty" than for the full tube.—Sir William **Bragg**: The crystal structure of ice. The methods of X-ray analysis have been applied to ice by Ancel St. John and by D. M. Dennison. The former refers the structure to a lattice composed of right triangular prisms of side 4·74 Å.U. and height 6·65 Å.U.; the latter to a similar lattice of dimensions 4·52 Å.U. and 7·32 Å.U. respectively. The arrangement of the atoms was not found. On certain suppositions the arrangement can be found independently of direct X-ray analysis. Assume that each positive ion is surrounded symmetrically by negative ions, and *vice versa*; and, in view of the low density of ice, let the number of neighbours be in each case as small as possible. The crystal is to be hexagonal and to have the right density. Then each oxygen atom is at the centre of gravity of four neighbouring oxygens, from each of which it is separated by a hydrogen atom. The dimensions of the structure agree with Dennison's figures, and the calculated intensities of reflection agree well with the observed intensities recorded by Dennison.—Kerr **Grant**: A method of exciting vibrations in plates, membranes, etc., based on the Bernoulli principle. A plate placed close to a flanged orifice from which a stream of air or liquid is issuing is attracted towards the orifice. If the plate be mounted as a diaphragm it can be excited to strong vibration by a suitable blast, and a loud sound is produced with high efficiency.

Faraday Society, February 13.—Prof. A. W. Porter, president, in the chair.—J. R. **Partington**: The energy of gaseous molecules. The translational and rotational energies of gases are, at ordinary temperatures, approximately represented by the theory of equipartition, and any excess of C_v over 6 may be put down to internal motions. This excess is parallel to the activities of the gases. The translational energy may be represented on the quantum theory with a frequency equal to the collision frequency. The value of n in the equation $n=n_0(T/_{273})^n$, representing the effect of temperature on the viscosity, is related to the critical pressure (p_c in atm.) by the empirical equation $n=0{\cdot}642+0{\cdot}00116\,p_c+0{\cdot}0000399\,p_c^2$. The molecular heat of hydrogen may be represented empirically

by Debye's formula with a frequency $\nu = 6541/\sqrt{T}$. The molecular heat of nitrogen is very approximately given by a molecule based on Bohr's theory, with a frequency given by the gyrostatic formula.—U. R. **Evans**: Passivity and overpotential. (1) Where a metal is corroded by a liquid yielding an insoluble corrosion product, the latter may either cling to the metal, forming a thin protective covering (often invisible), or it may become dispersed in the solution; in the latter case it will not seriously interfere with corrosion. It is probably the relative values of the interfacial tension between the metal, corrosion-product, and solution that determines which will occur. (2) The activation of passive metals by chlorides is related to the known peptising action of metallic hydroxides by chlorides; the passivication by means of chromates is connected in part with the flocculating action of chromates. (3) The fact that metals with basic oxides are rendered active by acids and passive by alkalis, whilst those with acidic oxides tend to become passive in acids and active in alkalis, shows that the invisible protective layer is "of the nature of an oxide-film." But it seems wrong to identify it with any oxide known in the massive state; probably we have to deal with a layer of oxygen atoms connecting the metal on one side to the solution on the other. (4) Likewise, at a cathodically polarised electrode we probably have to deal with a layer of hydrogen nuclei connecting the metal to the liquid. The hydrogen is probably in a state intermediate between the elementary and the ionic, and by forming a link between metal and solution it serves to decrease the energy of the interface. Overpotential may be due to the energy needed to desorb the hydrogen.—A. W. **Porter**: Note on the vapour-pressure of ternary mixtures. The equation proposed for ternary mixtures in a previous paper is here applied to the case of mixtures of toluene, carbon tetrachloride, and ethylene bromide, and is found to be satisfactory.

Royal Meteorological Society, February 15.—Dr. C. Chree, president, in the chair.—C. E. P. **Brooks** and J. **Glasspoole**: The drought of 1921. The general rainfall in England and Wales was the least in 1921, so far as can be ascertained, since 1788. Individual long records indicated that over a considerable part of the south-east of England 1921 was the driest year for at least a century and a half. The months of 1921 were not individually so remarkable as was shown by a comparison with the driest months known to have occurred in the British Isles generally. As shown by a map of standard deviation of annual rainfall, 1881–1915, for the British Isles, the least fluctuations of annual rainfall occurred along the coast in the north-west, increasing to a maximum in the south-east and centre of the land masses. Constructing charts showing the distribution of barometric pressure over the globe during and preceding each of the great droughts, beginning with 1864, it is found that the conditions which commonly prevail during dry spells are high pressure over the British Isles, the greatest deviation from normal being usually over south-east England; low pressure over the Arctic regions, especially near Spitsbergen; and, generally, low pressure over the tropics. The first factor is related to the eleven-year sun-spot cycle, occurring most frequently two years after sun-spot minimum and three or four years after sun-spot maximum, so that it tends to recur every five or six years. Low pressure over the Arctic is related to ice conditions, and tends to recur every four or five years. Great droughts occur only when both these factors are favourable. With pressure low over the Arctic, two or three months' warning of a drought would be given by the development of high pressure over northern Russia.—T. **Kobayasi**: A cyclone which crossed the Korean Peninsula and the variations of its polar front The cyclone passed over a mountain range in Korea on March 25, 1918. It induced a secondary on the farther side of the range along the steering line, which extended upward until it joined with the primary; the secondary gradually grew stronger, and the original centre disappeared. The existence of the polar front was very distinctly marked, but complicated in character. There were two or more squall lines for one steering line.

EDINBURGH.

Royal Society, February 6.—Prof. F. O. Bower, president, in the chair.—J. M'Lean **Thompson**: The floral structure of *Napoleona imperialis*, Beauv. The flower structure of this curious African plant of the Myrtle family has remained a puzzle since the discovery of the plant in 1786. The flowers possess inside the corolla a series of petal-like growths, which it was held were produced during descent by transformation and replacement of cycles of stamens of a myrtle type of flower. These petaloid growths and the persisting cycle of stamens, which themselves are now partly sterile, are associated with a massy fleshy disc which surrounds the base of the style. The disc, stamens, and petaloid growths in question have now been shown from developmental study to have a common origin from a ring-like outgrowth which normally in the Myrtle family bears numerous groups of stamens, and were held to be the results of replacement of stamens during descent.—G. W. **Tyrrell**: The pre-Devonian basement complex of Central Spitsbergen. The rocks described constitute the basement which underlies the flat-lying Devonian and Carboniferous sediments in the region about the head of Klaas Billen Bay. They form the southern continuation of the extensive Wijde Bay region of Urgebirge, where these ancient rocks begin to be covered unconformably by a sedimentary mantle. Lithologically, they fall into a western zone of "Archæan" facies, consisting of quartz-schists, garnetiferous mica-schists, hornblende-schists and gneisses, lit-par-lit-gneisses, and augen-gneisses, with crystalline limestones; and an eastern zone consisting of slates, quartzites, and limestones similar to those of the Hecla Hoek system, the type-locality of which (Hecla Hoek, in Treurenberg Bay) lies exactly on the northern continuation of the line of strike of these rocks. Hence this group is believed to be of Hecla Hoek (probably Ordovician) age. The western schists and gneisses, while showing great similarities to rocks involved with the Hecla Hoek of the north-western mountains, may be much older, possibly even Archæan.

MANCHESTER.

Literary and Philosophical Society, November 1, 1921.—Mr. T. A. Coward, president, in the chair.—S. J. **Hickson**: Some early autographs of John Dalton. Variations in Dalton's handwriting were examined and attention was directed to certain family records.—R. W. **James**: The distribution of the electrons in atoms. When X-rays fall on an atom each electron of the atom probably becomes a source of scattered X-radiation; the waves scattered by the electrons in the direction of the incident light will be in phase, and the total amplitude scattered in this direction will be proportional to the number of scattering electrons. If the electrons in the atom lie at distances from the nucleus comparable with the wave-length of the X-rays, the waves scattered from the different

electrons in any direction making an angle with that of the incident radiation will not be in phase. Measurement of the intensity of the radiation scattered in different directions gives the diffraction pattern for the atom. The K_α doublet of rhodium falling on a crystal shows that each electron in the atom scatters independently. On the average, three or four electrons lie in the region near the edge of the atom, and the main concentration is much closer to the nucleus.

November 15.—Mr. R. L. Taylor, vice-president, in the chair.—S. **Chapman**: Certain integrals occurring in the kinetic theory of gases. In the kinetic theory of gases, if molecules are regarded as point-centres of force, the calculation of the intensity of the force from experimental determinations of gaseous viscosity depends upon numerical factors which have not hitherto been evaluated except in one case. The factors concerned have now been calculated in other cases.—J. E. **Jones**: The dynamics of collision of diatomic molecules. By the application of Maxwell's kinetic theory, a simple relation between the velocity with which the points of contact approach each other and the velocity with which they separate has been found; a simple relation between the impulse acting on each body at collision and the velocity of approach of the points of contact has been deduced and the impulse on collision calculated. The velocities after collision are then deduced from the ordinary dynamical equations of momentum.

PARIS.

Academy of Sciences, February 6.—M. Emile Bertin in the chair.—L. **Lecornu**: Some remarks on relativity.—M. **Hamy**: The determination by interference of the diameters of stars the superficial brightness of which is not uniform.—C. **Richet**, E. **Bachrach**, and H. **Cardot**: The tolerance of the lactic ferment to poisons. It has been shown that the lactic acid organism gradually grows accustomed to poisons present in the culture media. It is now proved that this is specific, in the sense that a ferment grown tolerant to the presence of one poison still remains sensitive to another. The lactic ferment may be made to tolerate the presence of two different poisons simultaneously.—F. **Widal**, P. **Abrami**, and J. **Hutinel**: Researches on the proteopexic insufficiency of the liver in dysenteric hepatitis. The test previously described by the authors (enumeration of the white blood corpuscles after drinking a glass of milk, fasting) proves whether the liver is completely arresting incompletely disintegrated proteids, and this has proved to be a most sensitive test of the proper functioning of the liver. In dysentery the liver may be extensively attacked without affecting the proteopexic function.—M. **d'Ocagne**: The comparative examination of various nomographic methods.—A. **de Gramont** and G. A. **Hemsalech**: The evolution of the spectrum of magnesium under the influence of increasing electrical actions. Applications to astrophysics. From a detailed study of the effects of temperature and of the strength of the electric field on the lines of the magnesium spectrum various conclusions of interest in astrophysics are drawn. It is dangerous to conclude that a star possesses a high temperature because the spark-lines predominate in its spectrum. It is important to study the character of each line.—C. **Guichard**: Networks which are several times Ω_{00}.—J. **Timmermans**, Mlle. H. **Van der Horst**, and H. Kamerlingh **Onnes**: The melting points of pure organic liquids as thermometric standards for temperatures below 0° C. The temperatures were determined by a platinum resistance thermometer, standardised against the helium thermometer, of nine carefully purified liquids. The range covered is between −159·6° C. (isopentane) and −22·9° C. (carbon tetrachloride), with an error of less than 0·1° C. Specimens of these standard liquids will be distributed to other institutions later on.—M. **Gevrey**: Remarks on quasi-analytical functions.—G. **Julia**: Series of rational fractions and integration.—T. **Carleman**: A theorem of M. Denjoy.—G. **Sagnac**: The projection of the light of periodic double stars and the oscillations of the spectral lines.—D. **Coster**: The L series of the X-ray spectrum. The X-ray spectra of a large number of elements (from Ta to Rb) have been remeasured. In general, the new results confirm earlier work, and also give support to the theory of structure of the Bohr atom. Details are given in cases where the new measurements are not in agreement with the earlier observers.—M. **Bedeau**: Measurement of the dielectric constant of gases and vapours by means of circuits with sustained waves.—C. E. **Guye** and R. **Rüdy**: A new mode of determination of the molecular diameters by the electromagnetic rotation of the discharge in the gases. Earlier work had shown that whilst the molecular diameters obtained by this formula were of the same order of magnitude as those obtained by the viscosity method, the results were greatly influenced by the presence of traces of impurities. In the present work great care was taken in the purification of the gases, and comparative figures for the molecular diameters obtained by the electromagnetic rotation and the viscosity methods are tabulated for oxygen, nitrogen, carbon dioxide, hydrogen, nitrous oxide, methane, and carbon monoxide. The two sets are in fair agreement.—L. **Guillet** and J. **Cournot**: The variations of the mechanical properties of metals and alloys at low temperatures. Results are given for the resilience and Brinell test at 20° C., −20° C., −80° C., and −190° C. of electrolytic iron, steels, and alloys.—P. **Jolibois** and R. **Bossuet**: The relations between the different oxides of uranium. At 500° C. in a vacuum the oxide UO_3 loses oxygen, giving rise to U_3O_8, and the reaction is irreversible. The same oxide is formed by heating UO_2 in oxygen.—P. **Lebeau**: The oxides of uranium. The only oxides of uranium which have a certain existence are UO_3, U_3O_8, and UO_2. The green oxides prepared at temperatures below 800° C. contain variable quantities of uranic anhydride, and change in composition in contact with moist air.—H. **Pélabon**: The action of selenium on gold. Gold is slightly attacked by selenium; the metal fixes a little selenium, and the selenium itself takes up a little gold.—E. **Grandmougin**: Some new derivatives of sulphobenzide.—G. **Dupont**: The composition of Aleppo essence of turpentine. This turpentine contains 95 per cent. of pinene, 1·14 per cent. of inactive bornyl acetate, and 3·8 per cent. of sesquiterpene.—G. **Mouret**: The eastern limit of the granitic massif of Millevaches.—P. **Glangeaud**: The Saint-Flour Oligocene basin. The Miocene Truyère flowing into the Allier.—P. **Négris**: Glacial phases in Greece.—R. **Bourret**: The strata in the north-east of Tonkin.—L. **Dussault**: The geology of western Tonkin.—E. **Saillard**: Composition of the wild beetroots.—R. **Stumper**: New observations on the poison of ants. The concentration of the formic acid in *Formica rufa* was found to vary between 21 and 73 per cent. of pure acid. Formic acid is always present in the Camponotinæ, but absent in Myrmicinæ and Dolichoderinæ.—M. **Doyon**: The incoagulability of the circulating blood provoked in the frog by injections of nucleic acids. Duration of the phase. Comparison with various anti-coagulants.—A. A. **Mendes-Corrêa**: The asymmetry of the skeleton of the upper

limbs.—MM. **Alezais** and **Peyron**: The histogenesis and origin of the chordomes.—E. **Burnet**: A new method of diagnosis of Mediterranean fever. The test proposed is the intradermal reaction produced by a drop of a broth-culture of *Micrococcus melitensis*.—M. **Léger** and A. **Baury**: The shrew, *Crocidura Stampflii*, and the plague in Senegal. This animal has been proved to carry plague, and also fleas. Its destruction should be carried out systematically along with the rat.

Official Publications Received.

Agricultural Research Institute, Pusa. Bulletin No. 123, 1921: The Bundelkhand Cottons: Experiment in their Improvement by Pure Line Selection. By B. C. Burt and Nizamuddin Hyder. Pp. iv +15. (Calcutta: Government Printing Office, 1921.) 4 annas.

Memoirs of the Department of Agriculture in India. Entomological Series, Vol. 7, No. 6: Life-Histories of Indian Insects. Diptera: *Sphyracephala Hearseiana*, Westw. By S. K. Sen. Pp. ii +33-38+plates 4 and 5. (Pusa: Agricultural Research Institute.) 12 annas; 1*s*.

Annals of the Transvaal Museum. Vol. 8, Part 3: New South African Heterocera. By L. B. Prout and A. E. Prout. Pp. 149-186. (Cambridge: At the University Press.)

Canada. Department of Mines: Mines Branch. Annual Report on the Mineral Production of Canada during the Calendar Year 1920. Pp. 80. (Ottawa.)

Report of the Department of the Naval Service for the Fiscal Year ended March 31, 1921. (Sessional Paper No. 39: A. 1922.) Pp. 38. (Ottawa.)

The Journal of the Institute of Metals. Edited by G. Shaw Scott. Vol. 26. Pp. x+760+34 plates. (London: Institute of Metals.) 31*s*. 6*d*. net.

Abridged Edition of Tide Tables for Vancouver and Sand Heads, B.C., and Slack Water for First Narrows and Active Pass, with Tidal Differences for the Strait of Georgia. Pp. 45. (Ottawa: Tidal and Current Survey, Naval Service Department.)

Memoirs of the Department of Agriculture in India. Chemical Series, Vol. 6, No. 2: The Effect of Environmental Factors on the Alkaloidal Content and Yield of Latex from the Opium Poppy (*Papaver Somniferum*), and the Bearing of the Work on the Functions of Alkaloids in Plant Life. By Dr. H. E. Annett. Pp. ii+59-154. (Calcutta: Thacker, Spink and Co.; London: W. Thacker and Co.) 2 rupees; 2*s*. 9*d*.

Proceedings of the Rochester Academy of Science. Vol. 6, No. 2: Minerals in the Niagara Limestone of Western New York. By A. W. Giles. Pp. 57-72. Vol. 6, No. 3: The Fungi of our Common Nuts and Pits. By C. E. Fairman. Pp. 73-115+plates 15-20. (Rochester, N.Y.)

Uganda Protectorate: Annual Report of the Department of Agriculture for the Nine Months ended 31st December, 1920. Pp. 67. (Kampala: Department of Agriculture.)

Calendario della Basilica Pontificia del Santissimo Rosario in Valle di Pompei per l'Anno 1922. Pp. 240. (Valle di Pompei: Scuola Tip. Pontificia.)

Diary of Societies.

THURSDAY, FEBRUARY 23.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. A. G. Perkin: Dyeing: Ancient and Modern (2).

INSTITUTION OF ELECTRICAL ENGINEERS, at 3.30 and 8.—Meeting in Commemoration of the First Meeting of the Society of Telegraph Engineers on February 28, 1872.

ROYAL SOCIETY, at 4.30.—C. D. Ellis: β-ray Spectra and their Meaning.—Prof. A. E. Conrady: A Study of the Balance.—Dr. J. S. Owens: Suspended Impurity in the Air.—R. V. Southwell: The Free Transverse Vibrations of a Uniform Circular Disc clamped at its Centre, and the Effects of Rotation.—A. E. Oxley: Magnetism and Atomic Structure. II. The Constitution of the Hydrogen-palladium System and other similar Systems.—T. Carleman and Prof. G. H. Hardy: Fourier's Series and Analytic Functions.—Prof. A. McAulay: Multenions and Differential Invariants. II. and III.

ROYAL SOCIETY OF MEDICINE (Balneology and Climatology Section), at 4.30.—Dr R. L. J. Llewellyn and others: Discussion on The Etiology of Gout.

CHILD-STUDY SOCIETY (at Royal Sanitary Institute, 90 Buckingham Palace Road, S.W.1), at 6.—A. E. Haves: Phonoscript.

INSTITUTION OF AERONAUTICAL ENGINEERS (at Royal Society of Arts), at 7.30.—Lt.-Col. Moore-Brabazon: The Early Days of Aviation (Presidential Address).

CONCRETE INSTITUTE, at 7.30.—H. K. Dyson: What is the Use of the Modular Ratio?

ROYAL SOCIETY OF MEDICINE (Urology Section), at 8.30.—Prof. P. J. Cammidge: The Source of the Amylolytic Ferment of the Urine.—Dr. G. A. Harrison: Glycosuria in Renal Disorders.

FRIDAY, FEBRUARY 24.

ASSOCIATION OF ECONOMIC BIOLOGISTS (in Botanical Lecture Theatre, Imperial College of Science and Technology), at 2.30.—Dr. J. Rennie: (*a*) The Present Position of Bee Disease Research; (*b*) Demonstration of Polyhedral Disease in Tipula Species.

ROYAL SOCIETY OF ARTS (Joint Meeting of the Dominions and Colonies and Indian Sections), at 4.30.—Prof. W. A. Bone: Brown Coals and Lignites: Their Importance to the Empire.

ROYAL SOCIETY OF MEDICINE (Study of Disease in Children Section), at 5.—Dr. C. P. Lapage and Dr. W. J. S. Bythell: Tonic and Atonic Hearts in Children (with Radiographic Illustrations).

PHYSICAL SOCIETY OF LONDON (at Imperial College of Science and Technology), at 5.—Dr. H. Levy: The Number of Radio-active Transformations as Determined by Analysis of the Observations.—Prof. C. H. Lees: A Graphical Method of Treating Fresnel's Formulæ for Reflection in Transparent Media.—Research Department of the General Electric Co., Hammersmith: Demonstrations of a Rapid Weighing Balance, and an Electrostatic Voltmeter.—F. C. Dyche-Teague: Demonstration of the Physical Properties of Cellactite.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—H. Main: A Pilgrimage to Provence.

INSTITUTION OF PRODUCTION ENGINEERS (at Institution of Mechanical Engineers), at 7.30.—G. W. Eastwood: Intensive Production of Automobile Bodies.

JUNIOR INSTITUTION OF ENGINEERS, at 8.—Prof. E. G. Coker: Curved Beams, Rings, and Chain Links.

ROYAL SOCIETY OF MEDICINE (Epidemiology and State Medicine Section), at 8.—Dr. Evelyn D. Brown: The Relation between Puerperal Septicæmia and other Infectious Diseases, with Reference to the Admission of Maternity Cases into Isolation Hospitals.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Prof. J. Joly: The Age of the Earth.

SATURDAY, FEBRUARY 25.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. E. A. Gardner: Masterpieces of Greek Sculpture (2).

MONDAY, FEBRUARY 27.

INSTITUTE OF ACTUARIES, at 5.—C. H. Maltby: Results of an Investigation into the Effects of Different Valuation Bases upon Surplus.

INSTITUTION OF MECHANICAL ENGINEERS (Graduates' Association Meeting), at 7.—Sir Henry Fowler: Metallurgy in Relation to Mechanical Engineering.

ROYAL SOCIETY OF ARTS, at 8.—Prof. A. F. C. Pollard: The Mechanical Design of Scientific Instruments (Cantor Lecture) (2).

ROYAL SOCIETY OF MEDICINE (Odontology Section), at 8.—Clinical Evening.

MEDICAL SOCIETY OF LONDON (at 11 Chandos Street, W.1), at 8.30.—G. G. Turner, Sir Lenthal Cheatle, W. H. Clayton-Greene, W. James, and W. G. Howarth: Discussion on The Treatment of Tuberculous Glands.

TUESDAY, FEBRUARY 28.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir Arthur Keith: Anthropology of the British Empire: Series 1: Racial Problems in Asia and Australasia (2).

ROYAL SOCIETY OF MEDICINE (Medicine Section), at 5.30.—Dr. E. I. Spriggs and O. A. Marxer: A Review of Sixty-one Cases seeking Relief after Short-circuiting Operations.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—T. Bell: Present-day Portraiture.

ILLUMINATING ENGINEERING SOCIETY (at Royal Society of Arts), at 8.—L. Gaster and others: Discussion on Industrial Lighting: Ideal Requirements (legislative and otherwise) and Practical Solutions.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—Miss R. M. Fleming: Sex and Growth Features in Racial Analysis.

INSTITUTION OF AUTOMOBILE ENGINEERS (Informal Meeting) (at Institution of Mechanical Engineers), at 8.30.—Demonstration of, and Discussion on, Various Recording Instruments used on Motor Cars.

WEDNESDAY, MARCH 1.

NEWCOMEN SOCIETY (at Caxton Hall, Westminster), at 5.—R. Young: Timothy Hackworth and the Locomotive.

ROYAL SOCIETY OF MEDICINE (Surgery Section), at 5.30.—Informal Discussion on The Treatment of the Acute Obstruction resulting from Carcinoma of the Colon.

INSTITUTION OF ELECTRICAL ENGINEERS (Wireless Section), at 6.—E. B. Moullin and L. B. Turner: The Thermionic Triode as Rectifier.

ROYAL SOCIETY OF ARTS, at 8.—E. Moor: The Duplex-coupler Pianoforte.

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS (at Chemical Society), at 8.—R. V. Wadsworth: The Theobromine Content of Cacao Beans and Cocoa.—A. H. Bennett and F. K. Donovan: The Determination of Aldehydes and Ketones by Means of Hydroxylamine.—R. E. Esserv: The Value of Fish Scales as a Means of Identification of the Fish Used in Manufactured Products.—N. Evers and G. D. Elsdon: The Examination of B.P. Ointments.

THURSDAY, MARCH 2.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. H. M. Lefroy: The Menace of the Insect Pest: The Balance of Life in Relation to Insect Pest Control (1).

ROYAL SOCIETY, at 4.30.—*Probable Papers*.—Prof. L. N. G. Filon and H. T. Jessop: The Stress-optical Effect in Transparent Solids strained beyond the Elastic Limit.—W. E. Curtis: The Structure of the Band Spectrum of Helium.—S. Datta: The Spectrum of Beryllium Fluoride.—W. G. Palmer: The Catalytic Activity of

Copper. Part III.—Dr. G. B. Jeffery: The Motion of Ellipsoidal Particles immersed in a Viscous Fluid.—Dr. G. B. Jeffery: The Rotation of Two Circular Cylinders in a Viscous Fluid.

LINNEAN SOCIETY OF LONDON, at 5.—R. E. Holttum: The Flora of Greenland.—J. Walton: The Ecology of the Flora of Spitzbergen.—Sir W. A. Herdman: "Spolia Runiana," V.

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 5.30.—W. D. Douglas: Testing Aircraft to Destruction.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Discussion on Starters: Introductory Papers by C. H. Wordingham: The B.E.S.A. Specifications for Starters.—J. Anderson: Electric Motor Starters.—W. Wilson: Some Notes on the Design of Liquid Rheostats.

CHEMICAL SOCIETY, at 8.

ROYAL SOCIETY OF MEDICINE (Obstetrics and Gynæcology Section), at 8.—G. Luker: A Wandering Silk Suture Removed from the Urethra as a Sequel to Cæsarean Section.—Dr. C. D. Lochrane: Decidual Reaction in Adenomyoma of Vaginal Wall.—Dr. R. A. Gibbons: Sterility with Reference to the State.

FRIDAY, MARCH 3.

ROYAL SOCIETY OF MEDICINE (Laryngology Section), at 4.45.—E. M. Woodman, Dr. Reginald Morton, and others: Discussion on The Treatment of Malignant Growths of the Nasal Accessory Sinuses.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Geophysical Discussion on The Depth of Earthquake Foci. Chairman: Sir Frank Dyson. Speakers: Prof. H. H. Turner, Dr. J. W. Evans, Dr. Dorothy Wrinch, Dr. H. Jeffreys.

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.—A. P. Bale: Spiral Bevel *v.* Straight-tooth Bevel.

JUNIOR INSTITUTION OF ENGINEERS, at 8.—E. T. Elbourne: Factory Administration.

ROYAL SOCIETY OF MEDICINE (Anæsthetics Section) (Annual General Meeting), at 8.30.—Dr. Z. Mennell: Anæsthesia in Intracranial Surgery.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Dr. C. M. Wenyon: Microscopic Parasites and their Carriers.

SATURDAY, MARCH 4.

INSTITUTION OF LOCOMOTIVE ENGINEERS (at Caxton Hall, S.W.1), at 2.15.—J. Clayton: Lubrication of the Modern Locomotive.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir Ernest Rutherford: Radio-activity (1).

PUBLIC LECTURES.

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

THURSDAY, FEBRUARY 23.

INFANTS' HOSPITAL (Vincent Square, S.W.1), at 4.—Dr. W. M. Feldman: The Physiology and Pathology of the New Born; Initial Loss of Weight: Icterus Neonatorum.

UNIVERSITY COLLEGE, at 5.15.—Prof. J. E. G. de Montmorency: Welsh and Irish Tribal Customs (3).

KING'S COLLEGE, at 5.30.—Dr. O. Faber: Reinforced Concrete (6).

ST. JOHN'S HOSPITAL FOR DISEASES OF THE SKIN (Leicester Square, W.C.2), at 6.—Dr. W. Griffith: The Bullous Eruptions (Chesterfield Lecture).

BIRKBECK COLLEGE, at 8.—G. Bernard Shaw: The Failure of Education.

FRIDAY, FEBRUARY 24.

METEOROLOGICAL OFFICE (South Kensington), at 3.—Sir Napier Shaw: The Structure of the Atmosphere and the Meteorology of the Globe (6).

CANCER HOSPITAL (Fulham Road, S.W.3), at 4.—W. E. Miles: Cancer of the Rectum.

UNIVERSITY COLLEGE, at 5.—Prof. G. Elliot Smith: The Evolution of Man (3).

TAVISTOCK CLINIC FOR FUNCTIONAL NERVE CASES (at Mary Ward Settlement, Tavistock Place, W.C.1), at 5.30.—Dr. H. Crichton Miller: The New Psychology and its Bearing on Education (5).

SATURDAY, FEBRUARY 25.

LONDON DAY TRAINING COLLEGE, at 11 a.m.—Prof. J. Adams: The School Class (6).

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Dr. W. A. Cunnington: Man's Sphere in Savage Africa.

MONDAY, FEBRUARY 27.

CITY OF LONDON (BOYS') SCHOOL (Victoria Embankment), at 5.30.—Miss Rosa Bassett: The Dalton Plan of Self-education (4).

TUESDAY, FEBRUARY 28.

IMPERIAL COLLEGE—ROYAL SCHOOL OF MINES, at 5.30.—Col. N. T Belaiew: The Crystallisation of Metals (2).

LONDON SCHOOL OF ECONOMICS AND POLITICAL SCIENCE, at 6.—Sir Josiah Stamp: The Administrative Factor in Government (3).

WEDNESDAY, MARCH 1.

EAST LONDON COLLEGE, at 4.—Prof. F. E. Fritch: Certain Aspects of Freshwater Algal Biology (3).

LONDON (R.F.H.) SCHOOL OF MEDICINE FOR WOMEN, at 5.—Dr. H. H. Dale: Some Recent Developments in Pharmacology (2).

HORNIMAN MUSEUM (Forest Hill), at 6.—W. W. Skeat: The Living Past in Britain (6).

UNIVERSITY COLLEGE, at 8.—The Current Work of the Biometric and Eugenics Laboratories (3).—Dr. P. Stocks: Scheme of Anthropometric Measurements in the Biometric Laboratory.

THURSDAY, MARCH 2.

INFANTS' HOSPITAL (Vincent Square, S.W.1), at 4.—Dr. W. M. Feldman: The Physiology of the Infant (1).

SCHOOL OF ORIENTAL STUDIES, at 5.—Dr. L. D. Barnett: The Hindu Culture of India (1).

UNIVERSITY COLLEGE, at 5.15.—Prof. J. E. G. de Montmorency: Welsh and Irish Tribal Customs (4). At 5.30.—Dr. C. Pellizzi: Giardano Bruno in Inghilterra (In Italian).

KING'S COLLEGE, at 5.30.—Dr. O. Faber: Reinforced Concrete (7).

ST. JOHN'S HOSPITAL FOR DISEASES OF THE SKIN (Leicester Square, W.C.2), at 6.—Dr. W. Griffith: The Treatment of Skin Diseases (Chesterfield Lecture).

CIVIC EDUCATION LEAGUE (at Leplay House, 65 Belgrave Road, S.W.1), at 8.15.—Miss Margaret Tatton and others: Discussion on Art in Relation to Education.

FRIDAY, MARCH 3.

METEOROLOGICAL OFFICE (South Kensington), at 3.—Sir Napier Shaw: The Structure of the Atmosphere and the Meteorology of the Globe (7).

UNIVERSITY COLLEGE, at 5.—Prof. G. Elliot Smith: The Evolution of Man (4).

TAVISTOCK CLINIC FOR FUNCTIONAL NERVE CASES (at Mary Ward Settlement, Tavistock Place, W.C.1), at 5.30.—Dr. H. Crichton Miller: The New Psychology and its Bearing on Education (6).

SATURDAY, MARCH 4.

POLYTECHNIC (Regent Street, W.1), at 10.30 a.m.—Prof. A. Harden: Vitamins.

LONDON DAY TRAINING COLLEGE, at 11 a.m.—Prof. J. Adams: The School Class (7).

HORNIMAN MUSEUM (Forest Hill), at 3.30.—F. Balfour-Browne: Dragon-flies and their Life-history.

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